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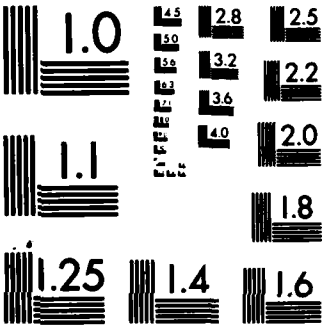

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This report is one of 23 subbasin reports produced by the St. Paul District Corps of Engineers in connection with a reconnaissance report for the whole of the Red River Basin. The reconnaissance report is itself part of the overall Red River of the North study, which was initiated by Congress in 1957 in order to develop solutions for flooding problems within the basin.
The purpose of a reconnaissance study is to provide an overview of the water and related land resource problems and needs within a particular geographic area, to identify planning objectives, to assess potential solutions and

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problems, to determine priorities for immediate and longrange action, and to identify the capabilities of various governmental units for implementing the actions.

The information developed in this report has been combined with information developed in the other subbasin reports to produce a main report covering the basin as a whole. The various flood control measures discussed in this and in other subbasin reports are combined in the main report to develop the outline of an integrated flood control plan for the basin within the context of a comprehensive plan.

The Wild Rice-Marsh Rivers Subbasin occupies 1,950 square miles of the central Minnesota portion of the Red River Basin and covers portions of the counties of Norman, Mahnomen, Polk, Clearwater, Clay, and Becker. It is bordered on the north by the Sand Hill and Red Lake River subbasins, on the south by the Buffalo and Ottertail subbasins, and on the west by the Main Stem Subbasin. The subbasin has attained a legal status through the formation of the Wild Rice Watershed District.

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RECONNAISSANCE REPORT: RED RIVER OF THE NORTH BASIN, WILD RICE-MARSH RIVERS SUBBASIN

Prepared for:

U.S. Army Corps of Engineers
St. Paul District
St. Paul, Minnesota

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This report is one of 23 subbasin reports produced by the St. Paul District Corps of Engineers in connection with a reconnaissance report for the whole of the Red River Basin. The reconnaissance report is itself part of the overall Red River of the North Study, which was initiated by Congress in 1957 in order to develop solutions for flooding problems within the basin.

The purposes of a reconnaissance study are to provide an overview of the water and related land resource problems and needs within a particular geographic area, to identify planning objectives, to assess potential problems and solutions, to determine priorities for immediate and long-range action, and to identify the capabilities of various governmental units for implementing the actions.

The Wild Rice-Marsh Rivers Subbasin is a water resource planning unit located in the southern Minnesota portion of the Red River Basin. This report describes the social, economic, and environmental resources of the subbasin; identifies the water-related problems, needs, and desires; and suggests measures for meeting the needs, particularly in the area of flood control.

The report was prepared almost entirely on the basis of secondary information. However, some telephone contacts were made to verify information and to acquire a more complete picture of local conditions. The only comprehensive report available on the subbasin is the Wild Rice Watershed District's Overall Plan, which was published by the Minnesota Water Resources Board in 1974. Other published sources on the subbasin include:

1. Wild Rice River, Minnesota, Letter from the Secretary of the Army, which was published by the U.S. Department of the Army in 1968 and is an interim survey report on the Wild Rice River.
2. Plan of Survey, Phase I, Plan Formulation Design Memorandum, Twin Valley Lake, Minnesota, for Flood Control and Related Purposes, which was published by the St. Paul District Corps of Engineers in 1973 and is a plan of study for the Twin Valley Lake project.

3. Flood Control, Twin Valley Lake, Wild Rice River, Minnesota, Design Memorandum, No. 2, Phase 1-General-Plan Formulation, which was published in 1975 and concerns flood control measures proposed for the area.

4. Design Memorandum No. 2, Flood Control, Twin Valley Lake, Wild Rice River, Minnesota, Economic Hydrologic Sensitivity Supplement, which was published by the St. Paul District Corps of Engineers in 1976 and is an economic evaluation of the Twin Valley Lake project.

5. Final Environmental Impact Statement, Twin Valley Lake-Wild Rice River, Minnesota, which was published by the St. Paul District Corps of Engineers in 1955 and concerns the proposed Twin Valley Lake project.

6. Minnesota Department of Natural Resources Division of Fish and Wildlife Ecological Services Section, Evaluation of Stream Characteristics and Fish Populations of the Wild Rice River near the proposed Twin Valley Reservoir, Minnesota, which was published by the Minnesota Department of Natural Resources and contains a study of the fish population in the Wild Rice River.

7. Questions and Answers Concerning the Twin Valley Lake Project, the Fish and Wildlife Compensation Plan, and the acquisition of Real Estate by the Government, which was published by the St. Paul District, Corps of Engineers in 1978.

8. Interim Survey Report on South Branch Wild Rice-Felton Ditch, Minnesota, Red River of the North Basin for Flood Control, which was published by the St. Paul District Corps of Engineers in 1965 and describes base conditions in the area.

9. South Branch Wild Rice River-Felton Ditch Minnesota, Letter from the Secretary of the Army, which was published by the U.S. Department of the Army in 1967 and is an interim report on the river and the ditch.

10. Plan of Study, Phase I, Plan Formulation Design Memorandum, Wild Rice River-South Branch and Felton Ditch for Flood Control, which was published by the St. Paul District Corps of Engineers and is a recommendation to improve the lower reaches of the Wild Rice River-South Branch and Felton Ditch.

11. Flood Control, Wild Rice River-South Branch and Felton Ditch, Minnesota, Design Memorandum No. 1, Phase I, General Plan Formulation and Hydrology, which was published by the St. Paul District Corps of Engineers in 1974 and is a plan for flood control measures.

12. Flood Control, Wild Rice River-South Branch and Felton Ditch, Minnesota, Design Memorandum No. 1, Phase 1, Part B-Hydrology, which was published by the St. Paul District Corps of Engineers in 1974 and is a separate appendix to the previous report that evaluates flood damages and benefits.

13. Final Environmental Impact Statement, Flood Control, Wild Rice River-South Branch and Felton Ditch, Minnesota, which was published by the St. Paul District, Corps of Engineers in 1974 and is the impact analysis of the proposed flood damage reduction plans.

14. Cultural Resources Investigation of the Wild Rice River-South Branch and Felton Ditch Flood Control Project Area, Clay and Norman counties, Minnesota, which was published by Impact Services Incorporated for the St. Paul District Corps of Engineers in 1979 and presents the results of a cultural resource investigation of the area.

15. Emergency Bank Protection, Wild Rice River at Mahnomen, Minnesota, which was published by the St. Paul District Corps of Engineers in 1978 and is an investigation of bank protection needs at Mahnomen.

16. Work Plan for Watershed Protection and Flood Prevention, Norman-Polk Watershed, Norman and Polk counties, Minnesota, which was published by the U.S. Department of Agriculture, Soil Conservation Service in 1974 and is a plan for watershed protection, flood prevention, and agricultural water management in the watershed.

17. Final Environmental Impact Statement, Norman-Polk Watershed, Norman and Polk counties, Minnesota, which was published by the U.S. Department of Agriculture in 1975 and is an environmental analysis of the proposed plan for flood prevention that includes land treatment and structural measures.

18. Upper Mississippi River Basin Commission, Proposal to Study, Red River Basin Surface Drainage Systems Management Special Study, which was published in 1979 by the Souris-Red-Rainy Regional Committee of the Upper Mississippi River Basin Commission in 1979 and is a proposal to study drainage in the Marsh Creek watershed and in the Rush River (North Dakota) area.

19. Tenth Annual Report, Wild Rice Watershed District, which was published in 1978 by the Wild Rice Watershed District and lists the projects in the watershed and discusses the status of each.

20. Status Report on Major Projects, Wild Rice Watershed District, Ada, Minnesota, which was prepared by the watershed district in 1980 and lists various projects completed, under construction, or under study within the Wild Rice Watershed District.

21. Application for Planning Assistance under the Watershed Protection and Flood Prevention Act, which was prepared by the East Agassiz Soil Conservation District and County of Norman, Minnesota in 1955 and is a request for assistance in developing a work plan for the Spring Creek Watershed.

In addition, the subbasin received partial coverage in the Souris-Red-Rainy River Basins Comprehensive Study, which was published by the Souris-Red-Rainy River Basins Commission in 1972, and in the Red River of the North Basin Plan of Study, which was published by the St. Paul District Corps of Engineers in 1977.

The information developed in this report has been combined with information developed in the other subbasin reports to produce a main report covering the basin as a whole. The various flood control measures discussed in this and in other subbasin reports are combined in the main report to develop the outline of an integrated flood control plan for the basin within the context of a comprehensive plan.

II. DESCRIPTION OF STUDY AREA

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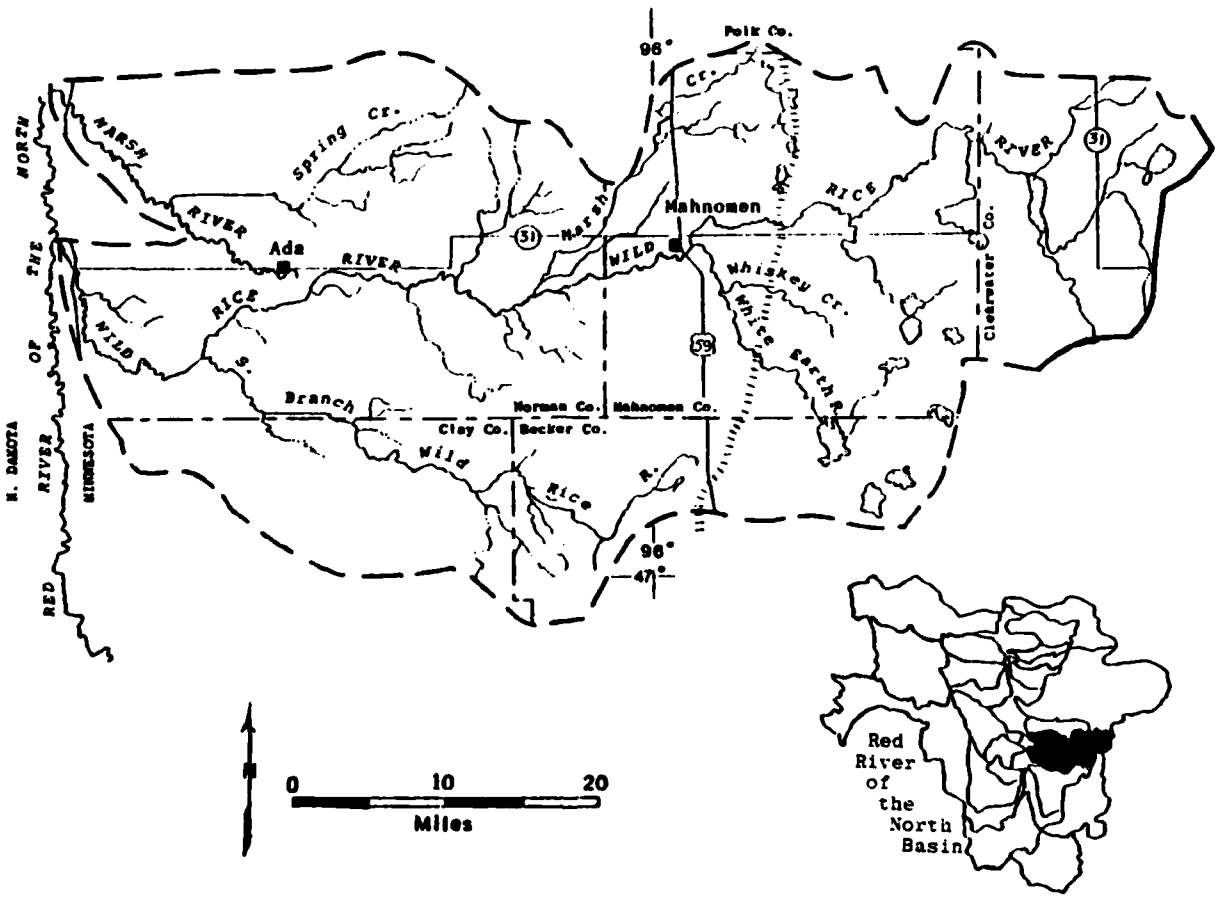
The Wild Rice-Marsh Rivers Subbasin (Figure I) occupies 1,950 square miles of the central Minnesota portion of the Red River Basin and covers portions of the counties of Norman, Mahnomen, Polk, Clearwater, Clay, and Becker. It is bordered on the north by the Sand Hill and Red Lake River subbasins, on the south by the Buffalo and Ottertail subbasins,and on the west by the Main Stem Subbasin. The subbasin has attained a legal status through the formation of the Wild Rice Watershed District.

In comparison to many of the other subbasins in the Red River Basin, the topography of the Wild Rice-Marsh Rivers Subbasin is varied. The upland areas in the east are gently undulating to rugged and are covered by forests and fairly large lakes. The uplands give way to an extensive beach ridge area that is more lightly forested and contains small lakes. Below the beach ridge area is the flat plain of the Red River Valley, which is practically devoid of forests and contains only a few small lakes. Elevations range from more than 1,500 feet in the upland area to only 860 feet near the Red River. In the north and south it is difficult to distinguish between the drainage areas of the Wild Rice-Marsh Rivers Subbasin on the one hand and the Sand Hill and Buffalo subbasins on the other.

The Wild Rice River begins at Lower Rice Lake in Clearwater County and flows westerly for about 160 miles before joining the Red River of the North about 30 miles north of Moorhead, Minnesota. The downstream 50-mile reach crosses the flat floor of the Red River Valley. In the latter part of the 19th century, a 10-mile long ditch was constructed by the Red River Drainage Commission to divert a part of the Wild Rice flood flows into the Marsh River. Of the total drainage area, about 300 square miles are in the Marsh River watershed. Above the point of diversion, about three miles east of Ada, the Wild Rice River drains 1,080 square miles.

Above river mile 55, the valley of the Wild Rice River has a maximum width of about 2,000 feet and a maximum depth of about 75 feet. Between



Source: Gulf South Research Institute.

Figure I. WILD RICE-MARSH RIVERS SUBBASIN

miles 55 and 43, the valley banks gradually merge with the low channel banks. Below mile 43, a broad flat overflow plain borders the channel. From mile 27 to its mouth, the Wild Rice River becomes entrenched progressively deeper below the Red River Valley floor. At its mouth the Wild Rice River Valley is approximately 500 feet wide and 35 feet deep. The lower Marsh River Valley below mile 24 is similar to that of the lower reach of the Wild Rice River. At the mouth of the Marsh River the valley has a width of 400 feet and a depth of 45 feet.

Above the lower 50-mile reach, the slope of the Wild Rice River varies from about four to five feet per mile. Downstream for about 20 miles below the upland area, the slope gradually decreases from about four feet per mile to two feet per mile; and for the downstream 30-mile reach, the slope averages only one foot per mile. The slope of the entire Marsh River and ditch averages 2.3 feet per mile.

Before the diversion channel was constructed, the source of the Marsh River was in the low, flat terrain just south of Ada. The stream now heads about three miles east of Ada at the flow diversion structure on Marsh River ditch. The ditch trends just north of Ada and generally westerly for about 10 miles to its junction with the old Marsh River channel. From this point the Marsh River flows northwesterly about 35 miles to its confluence with the Red River of the North about 15 miles north of the mouth of the Wild Rice River.

The principal tributaries of the Wild Rice are the White Earth River, Marsh Creek, South Branch Wild Rice River, and Felton Ditch, with drainage areas of 202, 154, 243, and 159 square miles, respectively. The principal tributary of the Marsh River is Spring Creek, which has a drainage area of 135 square miles.

III. PROBLEMS, NEEDS, AND DESIRES

III. PROBLEMS, NEEDS, AND DESIRES

The primary water-related problems, needs, and desires in the Red River Basin are flood control, fish and wildlife conservation and enhancement, recreation, water supply, water quality, erosion control, irrigation, wastewater management, and hydropower. Various water-related problems, needs, and desires have been identified for the Wild Rice-Marsh Rivers Subbasin in previous planning reports on the basis of analysis of conditions and public and agency comments. The list of problems, needs, and desires for the subbasin is the same as the list for the Red River Basin as a whole, with the exception of hydropower. Each problem is discussed separately below, with an emphasis on flooding problems.

Flooding Problems

Nature of The Problems

As with other Red River subbasins, the development of the Wild Rice-Marsh Rivers Subbasin owes much to the growth of the agricultural economy. This has resulted in floodplain encroachment, particularly in the extensive area of the Red River valley floor. It should be noted, however, that the flatness of the area precludes any sort of floodplain definition, and most encroachment can be attributed simply to the lack of high ground.

Floods on the Wild Rice and Marsh rivers usually occur during the months of April, May, and June, although floods have occurred in all months from March through July. Most of the damage from runoff results from snowmelt, often increased by spring rains. During the early stages of snowmelt, river channels are often clogged by hardpacked snow and ice. During some years, ice jams have been known to increase river stages by several feet.

When conditions are otherwise favorable to runoff, additional water from spring rains frequently compounds the extent of high flows or serves to increase their duration. Such occurrences usually cause a delay in crop seeding. Because of the limited growing season, this results in a reduction of yields.

Besides snowmelt flooding in the spring, there is a significant amount of flooding from high-intensity rains during summer months. During the larger floods, waters usually remain above flood stage for several days. Numerous lakes in the upper portion of the subbasin above Twin Valley also tend to delay the rate of recession of floodwaters. All of this can cause damage to growing crops. Sugar beets are especially sensitive to prolonged flooding, although other crops are also damaged from short periods of inundation.

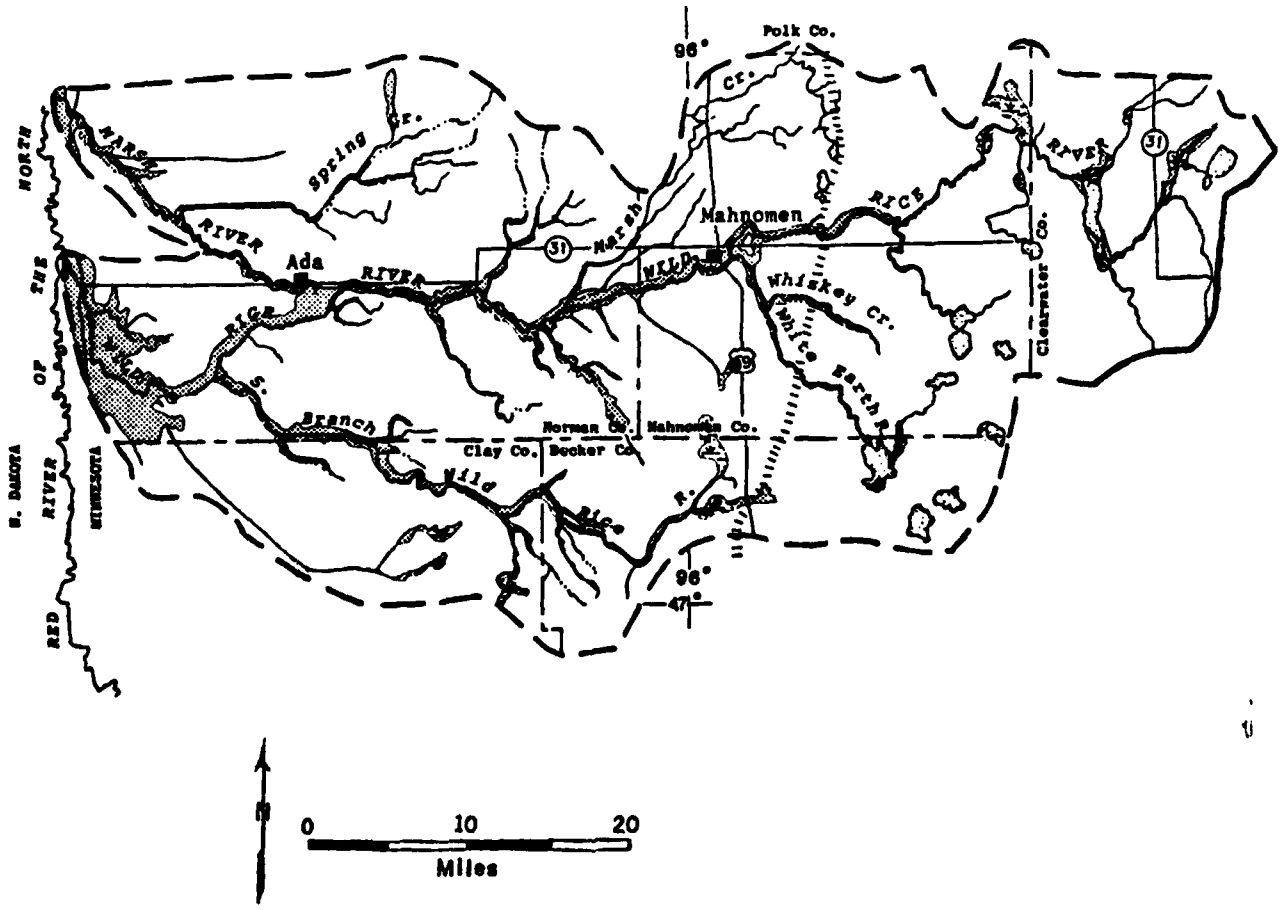
Two separate types of flooding occur: the most damaging type associated with river bank overflow (overbank flooding) and another type caused by runoff from snowmelt or heavy rainfall impounded by plugged culverts and ditches within sections of land bounded by roadways on earthern fill (overland flooding). In overland flooding, the trapped water slowly accumulates until it overflows the roadways and inundates section after section of land as it moves overland in the direction of the regional slope until reaching river or stream channels.

Topography also has a bearing on flooding problems in the Wild Rice-Marsh Rivers Subbasin. In the gently rolling headwaters above the beach ridges, flows are generally contained in definable areas. As the Wild Rice River crosses the beach ridge area and enters the flat valley plain, the gradient lessens and the channel capacity decreases. Flood waters then begin to escape the channel, moving overland and inundating thousands of acres in the western half of the subbasin. Disruption of transportation facilities in this area as well as damage to cropland, roads, bridges, and farmsteads is the result.

The subbasin contains about 5.0 percent of the total drainage area of the Red River, and subbasin runoff constitutes about 6.2 percent of the total Red River flow at the international boundary.

Location and Extent

The 100-year floodplain for the Wild Rice and Marsh rivers is delineated in Figure II. Prior to this study, no attempt had been made to compile even a generalized delineation of the entire floodplain. A number of sources were utilized, including: (1) U.S. Geological Survey (USGS) Flood Prone Area Maps (Scale 1:24,000); (2) Federal Insurance Administration



Source: Gulf South Research Institute.

Figure II. 100-YEAR FLOODPLAIN

flood maps; (3) published secondary sources describing flooded areas; and (4) USGS 7 1/2 minute topographic maps.

Figure II is therefore a composite of available sources, supplemental where necessary by inferences from existing information. Because the sources were often incomplete and based on surveys differing in both detail and level of accuracy, it should be understood that the floodplain shown constitutes a generalized delineation intended only for planning purposes. A more complete description of sources and methodology is given in Appendix A.

According to this provisional delineation, the floodplains of the Wild Rice and Marsh rivers constitute approximately 70,000 acres. Major components include: Marsh River, 4,000 acres; upper Wild Rice River and associated marshlands, 12,000 acres; Middle Wild Rice River from the junction of Twin Lake Creek to a point about two miles east of Ada, 18,000 acres; lower Wild Rice River to the main stem, 22,000 acres; and the South Branch, 14,000 acres.

The Marsh River begins at the foot of the beach ridges associated with glacial Lake Agassiz and flows in a northwesterly direction to the Red River. Shortly before the turn of the century, a 10-mile long ditch was dug above the town of Ada to divert part of the Wild Rice floodwaters into the Marsh River, so that the Wild Rice appears to spilt into two parts on the valley floor. As shown in Figure II, the floodplain associated with the Marsh River is fairly uniform from one end to the other, averaging less than a quarter mile in width. One of the two ditches that drain into the marsh River has an area of marshland associated with it.

The headwaters of the Wild Rice River, including the upper portions of Twin Lake Creek and White Earth River, lie in the eastern third of the subbasin. The gently rolling area is heavily forested, filled with lakes, and part of the White Earth Indian Reservation. The floodplain in this area is relatively narrow, serving mainly to connect several large lakes and marshlands. The latter comprise most of the 12,000 acres in the floodplain.

The beach ridge area constitutes about the middle third of the subbasin. This area is generally denoted in Figure II by the presence of scattered

marshlands draining into both the Wild Rice and South Branch channels. The middle segment of the Wild Rice River, ending approximately two miles east of Ada, is similar in configuration and width to that of the Marsh River. The South Branch floodplain lies in both the beach ridge area and valley plain. It varies in width from mincr marshland connectors to over a mile wide at a point just south of the Norman-Clay county line.

The floodplain associated with the lower segment of the Wild Rice River constitutes about 22,000 acres, including two areas over two miles in width. The first area occurs south of Ada and has a floodplain approximately 2 by 2.5 miles in size. The second area, beginning about five miles west of the South Branch entrance and extending to the Red River, has a floodplain several miles wide for a distance of about 12 miles. An estimated 2,000 acres of the total for this area has been delineated in the Souris-Red-Rainy Type II Study as being associated with main stem Red River flooding.

Flood Damages

The primary areas affected by flooding throughout the subbasin's floodplain are urban, agricultural, and environmental in nature. The major flood-prone areas are located along the Wild Rice River between its confluence with the Red River and a point just above Ada and all along the Marsh River. In addition, high flows overtop the channel capacity of the South Branch practically every year. Ada and Hendrum are the two principal urban areas subject to flooding. Only urban and rural damages are taken into consideration in the computation of average annual damages.

Present average annual damages are estimated at $2,115,000. In comparison to the other subbasins, this is a substantial figure, accounting for six percent of the Red River of the North basinwide flood damage total. Average annual damages are divided into two basic classifications: Urban and rural. Urban damages include damages to residences, businesses (commercial and industrial) and public facilities (streets, utilities, sewers, etc.). Rural damages account for 88 percent of total average annual damages in the subbasin, and urban damages account for the remaining 12 percent.

Urban damages in the subbasin from the 1979 flood event and average annual urban flood damages are displayed in Table 1. Urban damages sustained in the subbasin as a result of the 1979 flood event were minor when compared to the average annual damage figures. Estimated residential damages from the 1979 flood event were $32,000, and average annual damages to this category were $125,000. Business (commercial and industrial) damages from the 1979 flood event were estimated at $25,600, again small in comparison to the average annual damage figure of $100,000. Damages to public facilities were estimated at $6,400 for the 1979 flood event, and average annual damages were estimated at $25,000. Total average annual urban flood damages are estimated at $250,000, and the 1979 flood event is estimated to have caused $64,000 in urban flood damages.

Rural damages (Table 2) incurred in the flood events of 1975 and 1979 far exceeded average annual damages in the subbasin. In the 1975 flood event, rural flood damages included $30.9 million of crops, followed by $17.4 million in other agricultural damages and $1.5 million in transportation damages. The 1979 flood event resulted in $3.1 million in crop damages, $245,000 in other agricultural damages, and $157,000 in transportation damages. Average annual rural flood damages are estimated at $1.3 million in crop damages, $338,100 in other agricultural damages, and $139,300 in transportation damages. Total rural flood damages were $49.9 million in the 1975 flood event and $3.5 million in the 1979 flood event, and are $1.8 million on an average annual basis.

Environmental Concerns

Problems related to the terrestrial resources of the subbasin are concerned with past and present land use trends that involve the clearing of native habitats in favor of agricultural production. This clearing has reduced the quantity and quality of prairie, wetland, and woodland habitats for plants and animals. The U.S. Army Corps of Engineers (1974) recognized the need to preserve and enhance prairie habitats for the prairie chicken, to acquire wetlands for waterfowl production, to preserve and enhance river bottom and valley slope woodlands, and to acquire and develop lands for wildlife in certain portions of the South Branch of the Wild Rice River-Felton Ditch area. The U.S. Soil Conservation Service

Table 1

WILD RICE-MARSH RIVERS SUBBASIN, ESTIMATED 1979 AND AVERAGE ANNUAL URBAN FLOOD DAMAGES (In Thousands of 1979 Dollars)

Category	1979	Average Annual
Residential	32.0	125.0
Business	25.6	100.0
Public	6.4	25.0
Total	64.0	250.0

Sources: Red River of the North Basin Plan of Study, April, 1977; Post Flood Report, 1979; Gulf South Research Institute.

Table 2

WILD RICE-MARSH RIVERS SUBBASIN, ESTIMATED 1975, 1979 AND AVERAGE ANNUAL RURAL FLOOD DAMAGES (Thousands of 1979 Dollars)

	Year		
Category	1975	1979	Average Annual
Crop	$30,917.8	$3,099.0	$1,294.6
Agricultural	17,415.5	245.0	338.1
Other Transportation	1,577.8	157.0	139.3
Total	49,911.6	3,501.0	1,772.0

Sources: Red River of the North Basin Plan of Study, April, 1977; Post Flood Reports, 1975 and 1979; Gulf South Research Institute.

(1974), in their work plan for the Norman-Polk Watershed, indicated the following needs: establish areas of natural beauty and scenic value with diverse areas of vegetation, establish and manage wildlife areas, and improve land quality by controlling erosion. The Wild Rice Watershed District (1971) indicated concern over potential land use changes on wildlife composition and densities, maintenance of present game habitat, and the creation and restoration of additional game habitat areas. Land problems related to terrestrial resources described by the Upper Mississippi River Basin Commission (1977) for the North Branch area included conversion of much of the area's environmental resources to agricultural uses, further agricultural and residential development in floodplain areas, damages to environmental resources from flooding and severe wind and water erosion, and extensive drainage of wetlands, small lakes, and ponds for agricultural development.

One aquatic resource problem pertains to inadequate streamflows during the late summer, fall, and winter months, which reduces the streams' abilities to assimilate wastes and meet minimum streamflow requirements for recreational and environmental uses (Upper Mississippi River Basin Commission, 1977). The U.S. Fish and Wildlife Service (1979) indicated that the fisheries of the Wild Rice River as a whole is severely limited as a result of low basic productivity and a restricted amount of favorable habitat for game and commercial species. It was stated that flood damage reduction projects have caused some of the low productivity of the river. The U.S. Army Corps of Engineers (1974) reported a need to preserve and enhance existing trout fishery habitats and systems in Felton Creek upstream from State Highway No. 9, since the supply of water suitable for management in the area was limited. Water quality problems that may be causing undesirable effects on aquatic biota include periods of low dissolved oxygen and high turbidities (Minnesota Pollution Control Agency, 1975; Upper Mississippi River Basin Commission, 1977). The drainage of wetlands and other small waterbodies for agricultural production, which was referenced above, have also adversely affected aquatic organism populations in the subbasin.

One Federal project of concern to both Federal and state regulatory agencies in terms of the impact on fish and wildlife resources and water

quality of the Wild Rice River has been Twin Valley Lake. This project involves the construction of an earthern dam and reservoir for flood control on the river near Twin Valley. Major impacts on fish and wildlife resources and water quality have been described by the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service (1978, 1979). Presently, coordination activities are taking place between the Corps of Engineers, Fish and Wildlife Service, EPA, Minnesota Pollution Control Agency, and others to mitigate potential adverse impacts to these resouces.

Recreation Problems

Recreation problems in the subbasin are related to the lack of water-based recreation opportunities in the western section, drainage of wetlands, and shoreline development practices. There are no lakes in the western section, and many of the streams are intermittent and experience periods of low flow, thereby diminishing recreational use. The lack of lakes and potholes also limits hunting opportunities, although the forested areas in the entrenched floodplain of the Wild Rice and Marsh rivers provide wildlife habitat.

Recreational potentials throughout the subbasin are affected by increasing drainage of wetlands, which destroys valuable wildlife habitat and increases pollution in lake areas through agricultural runoff. Shoreline development of the subbasin's eastern lakes is not as pronounced as in the Ottertail River Subbasin, although estimates have been made that resorts and private homes occupy from 25 to 50 percent of land around Twin Lakes and Strawberry Lake. Zoning ordinances have been passed to control erosion and pollution resulting from unplanned development.

Water Quality Problems

The Upper Mississippi River Basin Commission (1977) stated that in the North Branch of the Wild Rice River, major water quality problems were related to inadequate streamflows and municipal and agricultural waste pollution. Inadequate streamflows during late summer, fall, and winter months are affecting the assimilative capacity of streams and streamflow requirements for recreational and environmental uses. Wastewater management problems will be discussed in a later section. The Minnesota

Water Resources Board (no date) indicated that pollution may be occurring in the Wild Rice Watershed District from seepages from septic tanks and drainfields, and possibly from unguarded animal wastes and barnyards.

Although the sources of the problems cannot be specifically identified, the Minnesota Pollution Control Agency (1975) reported that the principal water quality problems of the subbasin were frequent violations of fecal coliform and turbidity standards and infrequent violations of the dissolved oxygen criterion.

In the western part of the subbasin, the chief groundwater quality problem is excessive levels of dissolved solids.

Water Supply Problems

Groundwater supplies for domestic and stock purposes are obtainable in most places in the subbasin. However, test drilling is required to locate sand and gravel deposits, except in the eastern outwash and ice-contact area. Lower beach ridge wells are unreliable and are subject to dry periods in summer months.

Groundwater quality is generally good, but is limited by hardness caused by the presence of calcium and magnesium ions. There is also a salinity hazard, which requries that water be analyzed for suitability before it is used for irrigation purposes.

Surface water supplies are not a viable alternative to the widespread use of groundwater in the subbasin, because both the Marsh River and South Branch of the Wild Rice River are intermittent and experience dry periods during summer months. Because of the topography in the western section of the subbasin, there is little natural storage potential and minimal groundwater contribution to surface sources. The Wild Rice River has a large storage capacity and receives significant groundwater contributions from outwash sand and gravel aquifers in the morainal area of the subbasin. However, the groundwater contribution to the river in the western portion of the subbasin is significantly diminished becasue of the depth of silt and clay deposits.

Contacts with local officials of the three largest communities in the subbasin revealed that only the town of Mahnomen has water supply problems. Town wells are located on the bank of the Wild Rice River,

and bank erosion of the river has caused local concern. The town has experienced reduced yields during summer months and is currently enlarging storage capacity by erecting a larger tank (300,000 gallon capacity), which will alleviate supply and pressure problems and increase the town's fire protection capability.

Erosion Problems

The soils of the subbasin are subject to erosion from wind and water. Erosion has a limited effect on the soil with respect to sustained cropland production but has a significant effect on drainage networks and other works of improvement. Deposits of sediments in the drainage systems have caused serious maintenance problems and have decreased the water holding capacity of lakes and streams. A soil loss of only one ton per acre, if adjacent to a drainageway, may totally block that section of the system. Erosion is common on ditch banks and bridge and culvert shoulders. Large annual expenditures are required to remove sediment from drains and to reconstruct eroded roads, ditches, and fields.

Streambank erosion is a serious problem. Land voiding and damages to bridges, culverts, roads, side inlets, telephone lines, and electrical lines are a direct result. Soil erosion from wind is present in late spring and fall when wind velocity is strongest. The quality of air is also affected, since airborne dust is prevalent during this time.

The slopes of the rolling country are much more susceptible to erosion than the soils of the plain. The uplands are already marked by "baldplates" resulting from the wasting away of the dark colored surface soils and the exposure of the light colored subsoils. Wind erosion is moderate in most places, but deep gullies occur on steep slopes where the natural tree cover has been removed for land cultivation.

Irrigation

Irrigation in Minnesota has been steadily increasing over the past forty years. Irrigation reduces the climatic risks involved in farming and allows more efficient crop production. The amount of irrigated acreage in the subbasin has increased, but not to the same degree as other subbasins.

Parts of the counties of Becker and Clay constitute the extreme southern portion of the subbasin. Between 1970 and 1974 Becker County increased its irrigated acreage from 275 acres to 945 acres, which was a 243 percent increase. Clay's irrigated acreage increased by 125 percent--from 1,200 acres to 2,700 acres.

The major portion of the subbasin, which includes Norman and Mahnomen counties, has heavy soils that are less suited to irrigation. Heavy soils have a higher water-holding capacity than sandy, well-drained soils, and they generally do not require irrigation to produce adequate crops.

The potential for increased irrigation in the subbasin is unknown because information about the surficial sand aquifers has not been documented. In addition, unstable farm incomes affect the farmers' ability to make the capital investments required to establish an irrigation operation.

Wastewater Management

Table 3 gives problems and treatment needs for the 13 point source dischargers (11 municipalities and two feedlots) in the subbasin as reported by the Minnesota Pollution Control Agency (1975). The information in the table indicates that the two feedlots are in compliance. The communities of Gary and Ogema, served by septic tanks, are providing inadequate treatment but have applied for facility improvements. Ulen, operating a system of trickling filters, needs to improve its treatment, since violations have occured with BOD and TSS. Problems have also occurred in Borup--poor operation and maintenance of primary and secondary ponds; Felton--possible leakage in primary and secondary ponds; and Hendrum--possible poor operation and maintenance of primary and secondary ponds.

The Minnesota Department of Pollution Control and Ecology (1975) also indicated that frequent violations have occurred with turbidity. It was stated that the cause, whether point or nonpoint, was unknown. The Soil Conservation Service (1974) in their report on the Norman-Polk Watershed revealed that wind and water erosion and sedimentation were major problems. The Minnesota Pollution Control Agency (1979) in their 208 planning package for agriculture showed the following sediment source types and contribution characteristics: (1) upland erosion--low to medium low; (2) streambank erosion--low to medium high; (3) drainage ditch erosion--low to high; and (4) gully and wind erosion--present.

Table 3

PROBLEMS AND TREATMENT NEEDS OF POINT SOURCE DISCHARGERS IN THE WILD RICE-MARSH RIVERS SUBBASIN

Discharger	Receiving Water	Problems	Treatment Needs	Other Planning Considerations
Weldon Nelson Farm Feedlot	Wild Rice River	No apparent problems if pond is properly maintained	None if pond properly maintained	--
Mahnomen	Wild.Rice River	No apparent problems	Adequate treatment	--
Waubun	Wild Rice River *via a ditch and* Spring Creek	No apparent problems	Adequate treatment	--
Twin Valley	Wild Rice River	No apparent problems	Adequate treatment	--
Gary	Wild Rice River via a ditch	Inadequate treatment	Construct facility	Applied for Step I & II Grants; Apply for NPDES *Permit 180 days prior to* discharge
Ogema	Uran Lake and Spring Creek	Inadequate treatment	Construct Facility; Phosphorus removal needed	Applying for Step I & II Facility Grants. Apply for NPDES permit 180 days proir to discharge
Ulen	South Branch Wild Rice River	Excessive levels of BOD & TSS	Improve treatment; Eliminate by-pass	Low on NNL
Borup	South Branch Wild Rice River via Co. ditch 10 via an unnamed ditch	Possible poor operation and maintenance BOD & TSS in violation	Operate at design level	Population very small and declining
Felton	Wild Rice River via a ditch	Ponds may leak	Unknown- No discharge to date	Ponds leak: Investigation required
Hendrum	Wild Rice River	Possible poor operation and maintenance	No needs if better operation is attained	Population projected to be stable
Ada	Marsh River	*No apparent problems*	*Should be adequate;* No discharge to date	--
Natco Inc. Feedlot	Wild Rice River via an unnamed ditch	No apparent problems if facility is properly operated	None if ponds properly maintained	--
Shelly	Marsh River	No effluent reports	Believed to be adequate	--

Source: Minnesota Pollution Control Agency, 1975.

Hydropower

There are no hydropower installations in operation within the subbasin, and it is unlikely that hydroelectric development will occur in the near future. The capacity of the proposed reservoir, Twin Valley Lake, is too low to properly supply the water needed for a hydropower plant. In addition, the Wild Rice River has an inadequate amount of flow (especially under winter freezing conditions) to recharge the reservoir.

Public Perception of Problems and Solutions

The public's perception of problems and solutions in the subbasin is reasonably well defined because the Corps of Engineers has held at least one public meeting in this area (October 1978) in connection with the construction of Felton Ditch. The subbasin is also organized into a watershed district. The Tenth Annual Report of the Wild Rice Watershed District, published in 1978, lists three specific projects about which public hearings were held in 1974, 1977, and 1978. The Overall Plan of the Wild Rice Watershed District, published in 1971, and the Norman-Polk Watershed Work Plan, published in 1974, contain other information regarding the public's perception of problems and solutions. These documents indicate public concern for flood control, fish and wildlife conservation, recreation, erosion control, water quality, and agricultural water management.

Flood control is the primary water-related need in the subbasin. The area subject to inundation is about 70,000 acres, of which 60 to 90 percent is under cultivation depending on location. Since much of the land in the subbasin has been cleared for agriculture, maintenance of wildlife is dependent on the preservation of remaining prairie grasslands, forests, and wetlands. Although lakes for fishing and other water-related recreation are more abundant than in most of the other subbasins, demand far exceeds the resources available. Land treatment for erosion control, water quality measures, and agricultural water management practices are all cited as needs.

Several flood control measures have either been constructed or are authorized for construction in the subbasin. In 1954, the Corps of Engineers completed 39 miles of channel improvement along portions of Wild Rice

River and Marsh River and the diversion ditch above Ada. In 1964, a 12-mile portion of the Wild Rice River was snagged and cleared. A large dam on the Wild Rice River just above Twin Valley has been authorized that would provide flood control, recreation, fish and wildlife enhancement, and silt retention. The Corps also has been authorized to provide emergency bank protection for Mahnomen and to make channel improvements along the South Branch, Wild Rice River and Felton Ditch.

Local interests, including the Wild Rice Watershed District, have completed numerous channel maintenance projects since 1954. Local landowners have initiated a number of individual projects since 1971, including retention dams for water control, erosion control, and wildlife enhancement. In addition, local interests with the assistance of the Soil Conservation Service have been authorized to make improvements to drainage ditches in the northwest portion of the subbasin.

Additional evidence for interest in flood control measures is contained in public hearings held in East Grand Forks in 1978 and 1979 before subcommittees of the Committee on Public Works and Transportation of the U.S. House of Representatives. From these documents, it is evident that residents of the Red River Basin consider flood control to be the primary water related need for the area and that they are interested in whatever solutions may be proposed by Federal, state, or local agencies.

IV. DESCRIPTION OF SUBBASIN RESOURCES

IV. DESCRIPTION OF SUBBASIN RESOURCES

This section of the report discusses the conditions of the water-related resources within the subbasin that would be affected by a comprehensive water and related land resources plan that centered on flood control measures.

Social Characteristics

The area of most of the subbasin is rural. Prior to 1970, the subbasin's population declined. Changes in farming practices reduced employment, and the industrial employment opportunities failed to compensate for the lost jobs in the agricultural sector. Between 1970 and 1977, however, the subbasin's population increased by 4.3 percent, reaching a figure of 21,460 in 1977. All of the counties within the subbasin experienced population increases except Norman, which decreased because of net out-migration (2.2 percent). Growth in Clay and Mahnomen counties was the result of natural increase (births minus deaths); in-migration (nine percent) accounted for the increase in Becker County. Preliminary figures for 1978 indicate that all counties except Norman will increase in population even though out-migration rates will range from three to four percent.

The population density increased slightly from 10.6 to 11 persons per square mile from 1970 to 1977. There are no large population centers in the subbasin. Ada, located on the Marsh River in the western part of the subbasin, is the largest town and has a population of 2,076, which remained stable during the seven-year period of analysis. The towns of Mahnomen, with a population of 1,249, and Twin Valley, with 697 in 1977, experienced a five percent and 20 percent decline, respectively. In the subbasin as a whole, population in the towns decreased about three percent; the rural population increased by about 7.3 percent, which indicates a reversal of declining population in the rural sector.

Contacts with selected local public officials indicate that the change in migration patterns is a result of the following factors: (1) a stabilization in the farm consolidation rate; (2) an increase in parental turnover of farms to grown children; and (3) increasing difficulty in finding employment in small towns and urban centers.

Communities in the subbasin are close-knit, which is indicated by: (1) rate of home ownership; (2) length of residence in the county; (3) place of work; and (4) ethnic background. Nine of the 12 towns in the subbasin are in Mahnomen and Norman counties. In both counties, 82 percent of the people own their homes. Approximately 68 percent of the 1970 population was living in the same residences as in 1965. Eighty-two percent of the people in Mahnomen County and 89 percent in Norman County were living within the same county. In Mahnomen County, 79 percent of employed persons lived and worked in the county. Norman County accounted for the highest percentage of people in the subbasin working in the county of residence, with 90 percent.

Most of the population is of Norwegian descent, with some German elements in the eastern portion of the subbasin. Minority groups constitute a very small portion of the total population; however, a portion of White Earth Indian Reservation, which encompasses all of Mahnomen and part of Clearwater and Becker counties, lies within the boundaries of the subbasin. Census data (1970) show a population of 2,659 for the reservation.

The sense of community within the subbasin has been strengthened by the formation of the Wild Rice Watershed District, which is responsible for the development of an overall water management plan for the watershed.

Economic Characteristics

Employment

Between 1940 and 1970, farm employment in the subbasin decreased while all other sectors showed gains in employment. The decrease in farm employment was the result of improved agricultural technology that emphasized mechanization and large-scale farming. These techniques made possible the cultivation of larger tracts of land by fewer and fewer people. Between 1970 and 1973, farm employment increased slightly throughout the subbasin, except in the counties of Becker and Clay. Agricultural employment has stabilized during the 1970s, and other sectors have continued to enjoy moderate increases. As a result, total employment increased from 7,821 in 1970 to 9,872 in 1977.

Agriculture, which presently accounts for at least 30 percent of the total labor force, will continue to be a major source of employment in

the majority of the counties in the subbasin. Agriculture is followed in importance by trade and services. Manfacturing employment does not account for a significant portion of the labor force.

Unemployment in the subbasin has averaged approximately seven percent during the 1970s. Employment is high during the spring and summer because of tourism and agricultural activities and during the fall because of harvesting and processing. All activities decrease during the winter and unemployment rises.

Income

Total personal income for the subbasin increased from $94 million to $148 million between 1969 and 1977 (as expressed in 1979 dollars). Farm income accounts for more than 60 percent of the total personal income, and cash grain sales account for more than half of the total farm income. Average per capita income (also in 1979 terms) during the same years increased from $4,581 to $6,892, which was 20 percent below the 1979 average income figure of $8,314 for the entire state. Although there has been an upward trend in both total personal and per capita income, fluctuating farm prices are the primary determinants of income changes form year to year. Also, severe flooding can cause sharp declines in income, as happened in 1975.

Business and Industrial Activity

Agriculture

The economy of the subbasin is primarily based on the production and sale of agricultural products. The production of small grains is the most important agricultural component. Approximately 67 percent (or 836,160 acres) of the subbasin's land area is under cultivation, and another seven percent is devoted to pasture.

The major crops grown in the subbasin are identified in Table 4. Wheat, which is the leading crop, accounts for more than 30 percent of the harvested acreage. Wheat is followed in importance by barley, sunflowers, oats, and hay, which collectively amount to 57 percent of the harvested acreage. Minor acreages of corn, sugarbeets, rye, potatoes, soybeans, and flax are also grown in the subbasin. A significant development in the past few years has been the emergence of sunflowers as a major crop.

Table 4

1978 CROP STATISTICS, WILD RICE-MARSH RIVERS SUBBASIN

Crop	Harvested Acres	Yield Per Acre	Total Production
Wheat	219,600	33.4 bushels	7,334,640
Barley	145,900	49.4 bushels	7,207,460
Sunflowers	100,470	1,550 pounds	155,728,500
Oats	72,600	57.3 bushels	4,159,980

Source: Gulf South Research Institute.

Cropping patterns within the floodplain are similar to those throughout the subbasin, but there is a greater emphasis on specialty crops. Wheat, barley, oats, sunflowers, and hay are grown in the floodplain.

Manufacturing

Most of the manufacturing establishments in the subbasin are involved in producing or processing agricultural products. Eight of the 19 manufacturers process feed and fertilizer. One of the industries is a creamery that produces whole milk. The largest manufacturer is a flour mill that employs between 100 and 250 people. There are two sawmills, one concrete products plant, one company that makes various machine parts, and one plant that makes wood products. The remaining manufacturers are newspaper and printing establishments. The majority of these industries are located in Ada, Mahnomen, and Twin Valley, which are the largest towns in the subbasin. Table 5 presents estimated manufacturing employment in the study area by two-digit Standard Industrial Classification (SIC) codes.

Trade

In 1977, total trade receipts for the subbasin exceeded $143 million (expressed in 1979 dollars). More than 55 percent (or $81.5 million) of the receipts were wholesale trade. Retail trade and selected service receipts were $62.4 million and $7.3 million, respectively, in 1977.

Table 5

MANUFACTURING ESTABLISHMENTS, WILD RICE-MARSH RIVERS SUBBASIN

SIC	Description	Estimated Employment
20	Food and Kindred Products	225
24	Lumber and Wood Products	20
27	Printing and Publishing	30
28	Chemicals and Allied Products	30
32	Stone, Clay, and Glass Products	20
35	Machinery, except Electrical	20
	TOTAL	345

Source: 1979-80 Minnesota Directory of Manufacturers.

Transportation Network

The subbasin is crossed from north to south by State Highways 9 (through Ada, Borup, and Felton) and 32 (through Gary, Twin Valley, and Ulen), and by Federal Highway 59, which passes through Bejou, Mahnomen, Waubun, and Ogema. These highways provide this rural area with access to major east-west highways such as Federal Highway 10, which travels to Fargo-Moorhead and the Port of Duluth. There are also numerous state and county roads that intersect the primary routes to the distribution centers of the state.

There are two Burlington Northern Railroad lines that parallel State Highways 9 and 32, and the Soo Line Railroad parallels Federal Highway 59. These railroad lines travel to the Fargo-Moorhead area, to the port of Duluth, and to Minneapolis-St. Paul. A natural gas pipeline traverses the subbasin in the vicinity of Ada, Borup, and Felton. Branches of this pipeline run to Fargo-Moorhead and Minneapolis-St. Paul. The pipeline is part of the 2,139 miles of natural gas pipeline in Minnesota. The only two airports in the subbasin are located in the towns of Ada and Mahnomen. These airports are primarily for local use, but the airport at Ada has a paved runway that can accommodate various types of small aircraft.

Land Use

Approximately 67 percent of the subbasin is under cultivation, 21 percent is forest, and 7 percent is pasture. Most of the cropland is in the flat valley plain located in the western half of the subbasin. There is significant forest acreage in the eastern half of the subbasin and along the Wild Rice River. Marsh and water areas (44,928 acres) amount to 3.6 percent of the total land use and are located primarily in the eastern half of the subbasin.

Land use in the floodplains of the Wild Rice and Marsh rivers does not differ significantly from land use in the rest of the subbasin. The floodplain in the western part of the subbasin is important for agriculture. East of Ada and Twin Valley, the floodplain has a large amount of forest acreage. Towns located in the floodplain include Shelly, Ada, Twin Valley, Fossum, Hendrum, and Ulen.

Environmental Characteristics

Climate

Weather observations are currently being obtained by the U.S. Weather Bureau at three stations, Mahnomen, Twin Valley, and Ada. Characterized by extreme variations in temperature and moderate precipitation, the normal mean monthly temperatures vary from 70°F to 6°F, with a normal mean temperature of 40°F. At Ada, the growing season between the last frost in the spring and the first frost in the fall averages 120 days. Normal annual precipitation for the subbasin averages 21.5 inches, with greater precipitation in the eastern portion and slightly less in the western portion. Approximately 71 percent of the annual precipitation occurs during the 5-month growing season, May through September. Snowfall is 15 percent of annual precipitation and averages about 32 inches a year.

Crop injury from excess moisture is more common in the western part of the area adjoining the Red River. Crop injury by drought occurs more frequently on the sandy soils of the central and eastern lake bottom plain.

Geology

The subbasin lies entirely within the Central Lowlands Province of the Interior Highlands Division. Glacial lake deposits, lakeshore deposits,

till, and a small amount of ice-contact deposits overlie Precambrian undifferentiated igneous and Metamorphic rock in the east and a small band of cretaceous, fine-grained sandstone and shell in the west. Clay and silt lake deposits dominate the flat plain bordering the Red River of the North.

A transition zone is formed by lakeshore deposits, delta sand, and gravel. Beach sand ridges separated by silty, swampy depressions are characteristic of this region. Aquifers located in beach ridges generally yield under 50 gpm to wells. The eastern half of the subbasin is formed by a hetergeneous mixture of clay, silt, sand, and gravel (known as till) interspersed with a band of ice-contact deposits. Wells in the ice-contact zone are capable of producing over 500 gpm for municipal, domestic, and industrial use. Mineral resources of the subbasin consist of sand and gravel deposits.

Biology

The North Central Forest Experiment Station and Minnesota State Planning Agency (no date) show elm-ash-cottonwood, aspen-birch, maple-basswood, and oak as the major forest types in the subbasin, The elm-ash-cottonwood type occurs in the floodplains of the Wild Rice, Marsh, and South Branch of the Wild Rice rivers and in the smaller tributary streams. It is particularly abundant in the Heiburg-Twin Valley-Faith area. The aspen-birch community is predominant in the eastern portion of the subbasin east of Mahnomen into Clearwater County. Some pine is intermixed with this community in the extreme eastern part. The maple-basswood type is common east of White Earth and from the Becker County line south. The oak type is located on the eastern shore of Strawberry Lake in Becker County. The U S. Army Corps of Engineers (1975) provides a more detailed description of the plant resources of the Wild Rice River basin, indicating that it is composed of mixed grass prairie, oak-savanna, deciduous forest and coniferous forest from west to east. Very little of the native prairie remains and is found mainly in scattered patches; the oak-savanna, dominated by bur oak and grasses and forbs, occurs on the well-drained sandy soils from the beach ridges to a few miles eastward, where it adjoins the maple-basswood forest. The coniferous forest is located east of the deciduous

forest and consists of pines, balsam fir, spruce and tamarack. The U.S. Fish and Wildlife Service (1978) reported that upland and lowland hardwoods, upland and lowland bush, grassland, and streambank were existing terrestrial habitats in the Twin Valley Lake and compensation alternative areas.

Mann (1979) depicts the Red River Valley Lake Plain, Glacial Lake Agassiz Beachlines, and Border-Prairie Transition as the major wetland zones in the subbasin. The lake plain zone is located in the flatter segments of the river valley floor in the western part of the subbasin in Norman and Clay counties. Most of the wetlands and native prairie have been converted to agricultural lands. The beachline zone occurs in eastern Norman and Clay counties and is composed of shallow marshes. The transition zone is formed primarily is Becker, Mahnomen, and Clearwater counties in the subbasin and contains the highest wetland densities.

Within the subbasin the habitats important to wildlife consist of the few remaining prairie remnants, woodlands, and wetlands. The grasslands once provided a dynamic and diverse ecosystem that supported an abundance of flora and fauna when found interspersed with wetlands. Much of this community has since been converted to cropland. The forested and bushy areas contain a greater variety of wildlife than any other major habitat type and, as such, should be preserved wherever possible. These environs provide breeding, nesting, feeding, and resting areas and serve as a corridor in floodplain areas for migration and movement of wildlife. The wetlands afford excellent habitats, depending on the type, for both aquatic and terrentrial biota. They are particularly important as production areas for waterfowl as well as for other game and non-game fauna.

The most abundant big-game animal in the subbasin is the white-tailed deer; 1978 harvest figures varied from 183 in Mahnomen County to 917 in Becker County. Some black bear are found in the eastern part of the subbasin, with a total of 3, 2, and 12 animals harvested from Mahnomen, Clearwater, and Becker counties, respectively, during 1978. A few moose are found in the headwaters region, and some have been observed near Syce and Faith. The principal upland game birds are the Hungarian partridge and ruffed grouse, which are found mainly in the eastern part of the subbasin. Some pheasant (less than one hen per square mile) and sharp-

tailed grouse (1-6 adult males/sq. mile) occur. Common furbearers include the mink, raccoon, red fox, and beaver. Small game mammals include the jackrabbit in the western portion and snowshoe hare and gray squirrels in the eastern part (Mann, 1979; U.S. Army Corps of Engineers, 1975; U.S. Fish and Wildlife Service, 1980).

Approximately 103 species of breeding birds have been reported from the region: non-native pest birds--three species; non-native game birds--two species; native game birds--15 species; and native non-game birds--87 species. Typical non-game bredding birds include the killdeer, mourning dove, barn swallow, and red-winged blackbird. Colonial bird nesting sites are located at Upper Rice Lake (Forster's tern) and the Felton-Ulen area (Franklin gull). Waterfowl production in the potholes and shallow marshes is important; major breeding species include the mallard and blue-winged teal. About 22 species of amphibians and reptiles have been reported from the region; common species include the American toad, chorus frog, red-bellied snake, and Plains garter snake. More than 40 non-game mammals have been reported from the counties in the subbasin. Typical species consist of the deer mouse, meadow vole, coyote, striped skunk, and short-tailed shrew (Henderson 1978 a and b, 1979 a and b; Henderson and Reitter, 1979; U.S. Army Corps of Engineers, 1975; U.S. Fish and Wildlife Service, 1980).

The Wild Rice River consists of a variety of aquatic habitats that include riffle areas, deep pools, and shallow sand flats (U.S. Fish and Wildlife Service, 1979). Naplin et al. (1977) studied the fish populations of the river. The most abundant fishes found included the golden redhorse, shorthead redhorse, silver redhorse, rock bass, and northern pike. The Wild Rice River has been classified by the Minnesota Department of Natural Resources as a warmwater gamefish (Class II) stream and receives heavy fishing pressure during the spring and early summer. The game fish most often fished for are walleye, sauger, and northern pike. Good walleye and northern pike fishing exists in the pools of the Beaulieu area and the lower part of the river near Hendrum. Highway 75 is also a favorite location for catching walleye and channel catfish, particularly in the fall. The Wild Rice River also has the potential to support a good smallmouth

bass population since its physical characteristics (alternating pattern of riffles and pools) are typical of some of Minnesota's best smallmouth bass streams. The horney head chub, Johnny darter, brook stickleback, white sucker, common shinner, and carp are the other small and rough fishes commonly found in the Wild Rice River (Naplin et al., 1977; U.S. Fish and Wildlife Service, 1979).

Aquatic insects (adults and larvae) common to the Wild Rice River include mayflies, midges, snipeflies, and caddis flies. The crawfish is a common arthropod in the watershed. Fingernail clams are the most abundant freshwater mollusk. Other common clams include limpets of the genera Lampsilis, Amnicola, Heliosoma, and Physa (U.S. Army CoE, 1974).

The game and lake resources of the counties comprising the subbasin are listed, by lake type, in Table 6. Norman and Mahnomen counties comprise most of this particular drainage basin and should, therefore, receive the most attention.

Water Supply

Groundwater resources are used for water supply throughout the subbasin. Aquifers are located primarily in the beach ridge and till areas. Wells drilled in thick clay lake deposits in the western portion of the subbasin yield enough water for livestock ponds, but they are not reliable sources for municipal and domestic supplies. Wells in the town of Ada, however, are drilled through clay to a depth of 250 to 350 feet where they enter permeable sand lenses in glacial drift. Ada used approximately 87.5 million gallons of water in 1972. Creameries located in the town account for a significant portion of the water usage.

The lower one-half to two-thirds of beach ridge deposits yield water to wells usually producing about 50 gpm. The lower one-third of ridges is usually unreliable. Twin Valley receives its water supply from wells drilled 150 to 250 feet in beach ridges aquifers and obtained 14.6 million gallons for municipal and industrial use in 1972.

The till area in the central portion of the subbasin generally yields less than 10 gpm to wells; however, deep wells produce greater amounts of water. The town of Mahnomen obtains water from wells drilled 50 to 150 feet and used approximately 31 million gallons for municipal purposes in 1979.

Table 6

FISH AND GAME LAKE RESOURCES, BY LAKE TYPE, IN THE COUNTIES INCLUDED IN THE WILD RICE-MARSH RIVERS SUBBASIN

	County									
	Norman		Mahnomen		Becker		Clay		Clearwater	
	Number	Acres	Number	Acres	Number	Acres	Number	Acres	Number	Acres
Dry Lake Basins[1]	0	0	4	262	32	2,379	2	68	1	24
Game Lakes[2]	5	144	188	7,326	249	20,709	57	1,930	47	7,394
Marginal Lakes[3]	0	0	57	5,413	263	25,669	36	2,026	35	2,110
Fish and Game Lakes[4]	0	0	0	0	0	0	0	0	0	0
Fish Lakes[5]	0	0	10	--	113	--	4	--	37	--
Unclassified Lakes[6]	0	0	5	1,466	48	6,019	1	38	28	3,601
Centrarchid Lakes[7]	0	0	2	1,520	22	13,013	3	399	7	2,290
Walleye Lakes[8]	0	0	2	1,567	13	13,056	0	0	0	0
Trout Lakes[9]	0	0	0	0	2	57	0	0	0	0

[1]Dry lakes as reported here include those basins that do not have standing water throughout the year. This includes drained lake basins, dry basins with emergent vegetation such as cattails, and shrub swamps.

[2]Game lakes are those lakes shallower than six feet that ordinarily contain water throughout the years. They are ordinarily designated as being Type III or Type IV marshes.

[3]Marginal lakes are those that range from six to 20 feet deep, winterkill, and frequently have rough fish populations. Lakes with inlets are most likely to have rough fish populations.

[4]Fish and game lakes are defined as lakes in which both the game and fish resources are of major importance. These are lakes with several distinct connected basins, some river lakes, impoundments (especially the navigation pools on the Mississippi River), and the northern pike--wild rice--waterfowl lakes.

[5]Fish lakes are those that do not winterkill and have maximum depths that are ordinarily more than 20 feet and average depths that are 10 feet or more. Some soft water lakes, however, have average depths less than 10 feet and do not winterkill, and some fertile shallow lakes have inflows of water that add sufficient oxygen to prevent winterkills.

[6]Unclassified fish lakes are those where sufficient information is available to determine that they do not winterkill and are definitely fish lakes, but data available do not justify further classification. This category also includes a few lakes that do not readily fall into the remaining categories. For example, rough fish lakes that do not winterkill.

[7]Centrarchid lakes are those having fish populations that are primarily composed of bluegills, pumpkinseed crappies, rock bass, largemouth bass, and/or smallmouth bass. These lakes frequently have good populations of northern pike. Some of these lakes contain populations of walleye that are either artificially maintained or are a natural population that is a small fraction of the total fish population. In the northeastern part of the state, smallmouth bass and rock bass tend to be the most important segments of a centrarchid population in a lake. Crappies and green sunfish are the centrarchids that occur most commonly in very eutrophic(48) southern lakes.

[8]Walleye lakes are those having walleyes, yellow perch, common suckers, northern pike, and frequently tullibee as the main constituents of the fish population. Sometimes these lakes have fair sized populations of centrarchids, but they tend to be restricted to protected areas such as shallower, weedy bays.

[9]Trout lakes are those containing known populations of trout, either naturally or by stocking.

Source: Peterson, 1971.

Aquifer in the ice-contact deposits of the eastern section of the subbasin yield substantial amounts of water to wells at 500 gpm or more. The Wild Rice-Marsh Rivers Subbasin is one of the few areas in the Red River of the North Bason with extensive ice-contact deposits. Water hardness is common throughout the subbasin; however, aquifers in the west yield softer water than those in the morainal area.

Water Quality

The uses of the surface waters in the subbasin are variable and range from propagation of rough fish and certain industrial uses to drinking water supply, propagation of trout, and most industrial uses. These waters have been classified as Effluent Limited (Minnesota Pollution Control Agency, 1975).

As mentioned earlier in the Problems and Needs discussion, water quality problems in the subbasin are concerned mainly with excessive concentrations of fecal coliforms and periodic violations with respect to turbidity and dissolved oxygen. The bacterial concentrations are of particular concern in the Wild Rice River, because it has been designated as a stream for swimming. The dissolved oxygen and turbidity violations degrade the quality of the water for game fish. Table 7 gives water quality data for the Wild Rice River near Hendrum for the period 1971-74.

Table 8 presents water quality data for the period October 1977-September 1978 in the Wild Rice River at Twin Valley and Hendrum. The parameters included in this table are those for which numerical criteria have been established. Turbidity levels at both stations can be excessively high, with average levels exceeding the state criterion at Hendrum. Total phosphorus concentrations are periodically high at both monitoring points, as is total nitrogen. Additional data from the U.S. Geological Survey (1979) in one sampling period indicated that no pesticides were apparent in either sediments or waters at Twin Valley. Some metals were reported from bottom sediments at this location, with values for barium, cadmium, chromium, cobalt, copper, lead, nickel, strontium, and zinc all at 10 ug/g. Aluminum was substantially higher, at 610 ug/g.

SURFACE WATER QUALITY DATA FOR THE W

Description	Flow (cfs)	Temperature (°F)		D.O. (mg/l)		BOD_5 (mg/l)		SS (mg/l)		Fecal Coliforms (MPN/100 ml)	
Water Quality Standards in this Segment		5° change 2B-66° Maximum		2B** 5-other times		--		2B-1		200	
	Average	Average		Average		Average		Average		Average	
Monitoring Stations	7-Day 10-Year Low	Maximum	Percent of Violation	Minimum	Percent of Violation	Maximum	Percent of Violation	Maximum	Percent of Violation	Maximum	Percent Violat
Wild Rice River WI-3 Bridge on USH-75 near Hendrum	2.2	52	0	8.6	7	2.1	--	0.14	0	467	33
30 reports 1971-74		72		1.0		5.6		0.6		3,500	

Source: Minnesota Pollution Control Agency, 1975.

Table 7

SURFACE WATER QUALITY DATA FOR THE WILD RICE RIVER NEAR

Flow (cfs)	Temperature (°F)	D.O. (mg/l)	BOD_5 (mg/l)	NH_3 (mg/l)	Fecal Coliforms (MPN/100 ml)	TDS (mg/l)
	5° change 2B-86° Maximum	2B** 5-other times	--	2B-1	200	700
Average 7-Day 10-Year Low	Average Maximum / Percent of Violation	Average Minimum / Percent of Violation	Average Maximum / Percent of Violation	Average Maximum / Percent of Violation	Average Maximum / Percent of Violation	Average Maximum / Percent of Violation
	52	8.6	2.1	0.14	467	339
2.2	0	7	--	0	33	--
	72	1.0	5.6	0.4	3,500	--

ution Control Agency, 1975.

...R NEAR HENDRUM FROM 1971-1974

	pH --	Turbidity (JTU)	Oil (mg/l)	NO_3 (mg/l)	Phosphorus (mg/l)	TSS (mg/l)
	6.5-9.0	25	2B 0.5	2B-none	--	--

	Average		Average		Average		Average		Average		Average	
...of ...n	Range	Percent of Violation	Maximum	Percent of Violation	Maximum	Percent of Violation	Maximum	Percent of Violation	Maximum	Percent of Violation	Maximum	Percent of Violation
	7.8		43				0.47		0.22		95	
	6.9-8.4	0	320	40	--	--	4.6	--	1.3	--	660	--

Table 8

SURFACE WATER QUALITY DATA FOR THE WILD RICE-MARSH RIVERS AT TWIN VALLEY AND HENDRUM, OCTOBER 1977 TO SEPTEMBER 1978

	State Criteria[1]	EPA Freshwater Aquatic Life Criteria[2]	Maximum		Minimum		Mean	
			Twin Valley	Hendrum	Twin Valley	Hendrum	Twin Valley	Hendrum
Flow (cfs)	--	--	4,530	9010	31	30	373	682
pH	6.5-9.0	6.5-9.0	9.0	8.6	7.4	7.1	8.2	7.5
Temperature (°C)	30°C (86°F) max.	--	27.5	27.0	0.0	0.0	12.7	13.9
Turbidity (JTU)	25	--	230	280	3	6	20	35
D.O. (mg/l)	5.0 mg/l min.	5.0 mg/l min.	13.6	13.0	5.9	4.9	9.6	8.7
Fecal Coliform (#/100ml)	200/100 ml	--	430,000	--	12	--	37,613	--
Dissolved Solids (mg/l)	700 mg/l	--	433	--	147	--	286	--
Total Nitrogen (mg/l N)	--	--	2.8	3.4	0.52	0.38	1.09	1.16
Total Phosphorus (mg/l P)	--	--	0.29	0.35	0.02	0.04	0.07	0.10
Ammonia (mg/l N)	1 mg/l	--	0.50	0.53	0.00	0.00	0.09	0.11
Iron (µg/l)	--	1000 µg/l	160	--	30	--	65	--
Arsenic (µg/l)	--	100 µg/l	6	--	4	--	5	--
Cadmium (µg/l		12.0 µg/l	<10	--	0	--	--	--
Chromium (µg/l)	50 µg/l	100 µg/l	20	--	10	--	12	--
Mercury (µg/l)	--	0.05 µg/l	0.5	--	0	--	--	--
Cyanide (µg/l)	0.02 mg/l	0.005 mg/l	0.00	--	0.00	--	0.00	--
Copper (µg/l)	10 µg/l	--	<10	--	3	--	--	--

[1] From Minnesota Pollution Control Agency, 1975.

[2] From U.S. Environmental Protection Agency, 1976.

Source: U.S. Geological Survey, 1979

Groundwater quality data for seven communities in the subbasin are shown in Table 9. The water is characteristically hard and is high in total dissolved solids. Iron concentrations in excess of the EPA's (1976) criteria for domestic supplies of 0.3 mg/l occur in nearly every community except Hendrum. However, this community has the greatest sulfate concentration, with a value of 350 mg/l (Winter et al., 1970).

Aesthetics

The rolling topography of the central and eastern portion of the subbasin provides relief from level terrain and offers many lakes and forested areas for aesthetic and recreational opportunities. The primary aesthetic resources of the subbasin are Little Elbow State Park and White Earth State Forest.

Little Elbow State Park, 16 miles east of Waubun, is situated on rolling hills with deciduous tree cover. Three lakes within the park provide fishing opportunities, with associated camping and picnicking facilities.

A portion of White Earth State Forest is located within the subbasin in the morainal region of Mahnomen, Clearwater, and Becker counties. White Earth, Beltrami Island, Buena Vista and Red Lake State are the state forests in the Minnesota portion of the Red River Basin, although Smokey Hills, Two Inlets, Mississippi Headwaters, and Paul Bunyan forests are nearby in Becker, Hubbard, and Beltrami counties. Because of the scarcity of large forest tracts in the Basin, the White Earth forest is a particularly significant aesthetic resource that provides residents with a rare contrast to the flat agricultural terrain characteristic of much of the subbasin.

Cultural Elements

Substantive evidence of early (Paleo) man in the subbasin is limited at this time. As late as 9900 B.C., much of the glacial Lake Agassiz plain remained poorly drained, swampy, and unsuited for habitation. In the entire Red River Valley, most of the early man sites are documented along the western (North Dakota) edge of the glacial lake plain (Johnson, 1962:162). However, significant archeological resources can probably be found along the former shores of Lake Agassiz (strandlines) that bisect the subbasin.

Table 9

GROUNDWATER QUALITY DATA FROM COMMUNITY WATER SUPPLIES IN THE WILD RICE-MARSH RIVERS SUBBASIN

Community	Well Depth (feet)	Total Dissolved Solids (ppm)	Hardness (ppm)	Fe (ppm)	SO_4 (ppm)
Ulen	110	498	392	0.46	60
Twin Valley	240	--	260	1.3	--
Shelly	258	--	120	2.9	41
	247	--	156	0.8	14
	140	678	--	--	--
Mahnomen	93	--	330	0.42	130
	130	--	380	0.68	130
Hendrum	300	--	170	0.23	350
	98	677	348	0.11	236
Ada	255	--	--	1.2	63
	262	--	72	--	28
	262	571	98	0.07	64

Source: Winter et al., 1970.

Two representative sites of a late prehistoric culture, called the Arvilla Complex, are located along the Campbell Beach Ridge. These Woodland burial mound sites, with few exceptions, are situated upon glacial strandlines in the Red River Valley and throughout central Minnesota (Wedel, 1961:226; Johnson, 1973:3, 58). There is no evidence to indicate that habitation sites are associated with these mound complexes (Johnson, 1973:5, 60). To date, there are 21 recorded archeological sites in the subbasin. Of these, 13 have Woodland components. Surveys of the Twin Valley reservoir site and parts of the Wild Rice River (Streiff, 1974) did not reveal any archeological sites. Large areas of the subbasin are as yet unsurveyed, and no archeological sites are reported in Mahnomen County, which represents approximately one-third of the study area. A recent survey of Clay County (Micholovic, 1978) should substantially improve archeological knowledge of parts of the subbasin. Micholovic's survey (1978:26-27) suggested the possible importance of major rivers and streams to prehistoric peoples. The association of archeological resources with major streams may have significant impacts on the development and implementation of flood control measures.

Related tribes of the Siouan language family were dominant in the Minnesota region during the seventeenth century. Immigrant members of the eastern Algonkian language family, most notably the Chippewa, challenged this domination, however, and eventually succedded in obtaining the northern half of the state. Remants of three bands of Algonkian speakers are located on the White Earth Indian Reservation in the eastern half of the subbasin.

After the Civil War, the pace of Euro-American settlement in the subbasin increased as settlers pushed west toward the Red River Valley. The rich and varied contributions of these settlers is reflectd in the 20 historical sites recorded within the subbasin. Of these, one is listed on the National Register of Historic Places. No historic sites have yet been recorded in Mahnomen County. Systematic archeological and historical surveys of these areas should substantially improve the inventory of cultural resources.

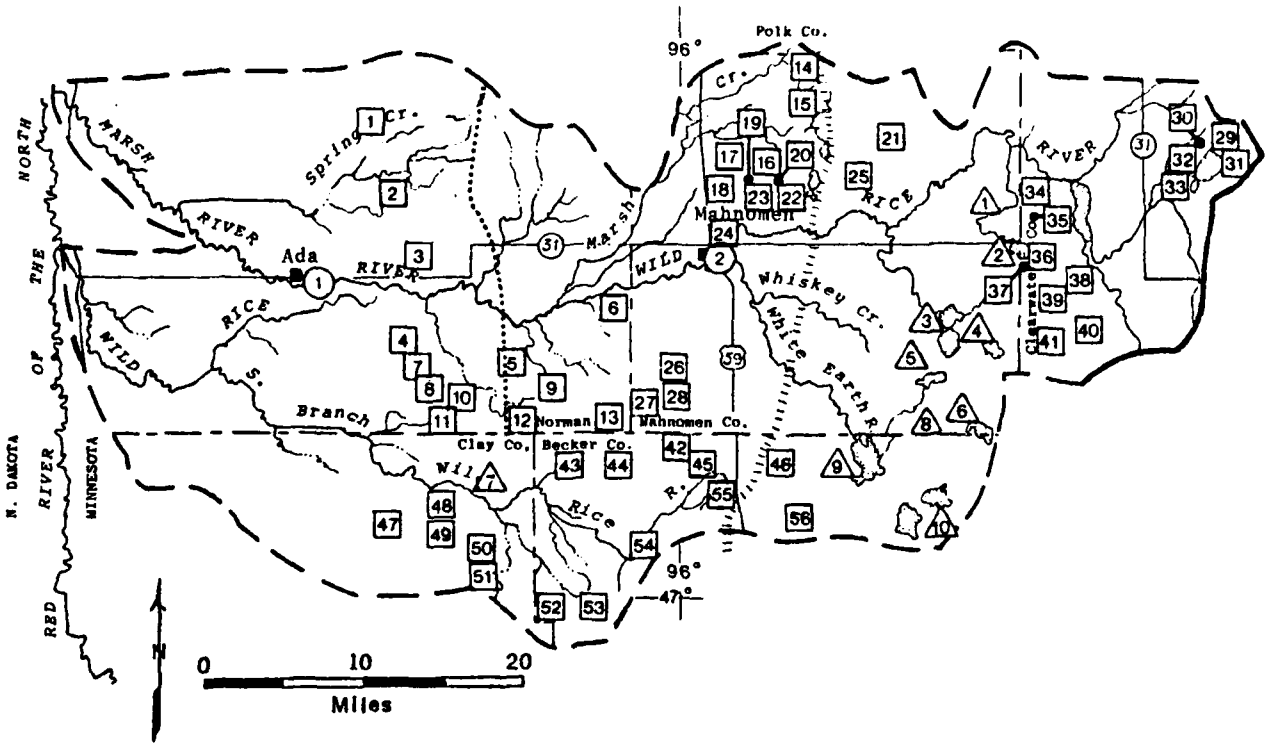
Recreational Resources

The distribution of recreational resources in the subbasin reflects the topography of the area. The central transitional zone and eastern uplands are characterized by a number of lakes, potholes, and marshes that provide the environmental prerequisites for wildlife habitat and water-based and water-related recreational activities. There are very few recreation sites in the flat western section.

The major recreational resources in the subbasin are Little Elbow Lake State Park and White Earth State Forest. Little Elbow State Park, comprising 3,127 acres, is 16 miles east of Waubun in Clearwater County and affords residents camping, fishing, boating, and picnicking opportunities. White Earth State Forest, with 41,617 state-owned acres, includes parts of Becker, Clearwater, and Mahnomen counties. A substantial portion of the forest is within the subbasin and provides opportunities for camping, snowmobiling, and other recreational pursuits. There are approximately 93 recreational sites in the subbasin, comprising about 24,000 acres, excluding the Little Elbow Lake Park and White Earth Forest. All areas with 15 or more acres, which account for 99 percent of the recreational acreage, are depicted in Figure III. An inventory of facilities for these sites in included in Appendix B of this report.

As illustrated in Figure III, wildlife management areas are concentrated in the central and western zones and constitute the vast majority (95 percent) of recreational lands in the subbasin. In addition, there are numerous Federal waterfowl production areas within the subbasin that are open to the public for waterfowl and upland, small, and big game hunting. Common species include sharp tailed grouse, pheasant, moose, and deer.

There are approximately 1,060 acres of privately owned recreation sites larger than 15 acres in size that have been developed in association with the larger lakes of the westrn portion of the subbasin. Twin Lakes, Bass Lake, and Strawberry Lake have attracted most of the resort development. Many year-round residences and summer homes have been built because of (in part) the recreational and aesthetic appeal of the area. Fishing is popular in these lakes; bass, northern pike, pan fish, and walleye are the most common species.



EXISTING WILDLIFE AREAS

1 Agassiz 2
2 Agassiz 1
3 Ida
4 Rockwell
5 Vangsness
6 Faith
7 Dalby
8 Neal
9 Home
10 Twin Valley
11 Cupido
12 Syre
13 Moccasin
14 Killian
15 Foot
16 Mahgre
17 Loncrace
18 Wambach
19 Gregory
20 Vanose
21 Budde Meadows
22 Warren
23 Rush
24 Mah Soo
25 Beaulieu
26 Bluestem
27 Coburn
28 Waubun
29 Clearwater 7
30 Clearwater19
31 Clearwater 5
32 Clearwater 20
33 Upper Rice
34 Jackson
35 Clearwater 34
36 Clearwater 27
37 Clearwater 26
38 Lower Rice
39 Clearwater 29
40 Clearwater 31
41 Clearwater 32
42 Spring Creek
43 Moccasin
44 Coburn
45 Olson
46 White Earth
47 Felton
48 Ulen
49 Aspen
50 Goose Prarie
51 Lemon
52 Melbye
53 Atlanta
54 Pednor
55 Ogema
56 Teiken-Dalve

EXISTING RECREATION AREAS

1 White Earth State Forest
2 Roy Lake Lodge Resort
3 Pine Hurst Resort and Campground
4 Broken Arrow Resort
5 Braulick's Resort
6 Little Elbow Lake State Park
7 Ulen Municipal Park
8 Mahnomen Co. Memorial Forest
9 Wabaunaquai Group Camp
10 Woodland Trails Resort

OTHER EXISTING RECREATION AREAS

1 Heart of the Valley Golf Course
2 Mahnomen Country Club

PROPOSED TRAILS

1 Pembima Trail

Source: Gulf South Research Institute.

Figure III. RECREATIONAL RESOURCES

The subbasin lies within regions 1 and 4 of the Minnesota State Comprehensive Outdoor Recreation Plan (SCORP). The 1979 draft SCORP lists hunting, fishing, swimming, camping, and snowmobiling as the primary demands for both regions. The central and western portions of the subbasin, however, have abundant hunting areas. Stream and lake fishing are also available and are supplemented by the proximity of the Lake Region. Little Elbow Lake State Park and White Earth State Forest provide significant recreational opportunities for area residents. Itasca State Park and Two Inlets State Forest are located within a short driving distance from the subbasin.

Proposed recreational sites in the subbasin are limited to expansion of existing municipal and county facilities and to further development of the Pembina Trail. The site commemorates a 126-mile, former ox-cart trail that passed through Norman and Polk counties.

Significant Environmental Elements

Social

The towns of Ada, Mahnomen, and Twin Valley are the population centers of the subbasin and are located along floodplains. Flooding problems affect town and county economic resources through damage to sewers, streets and roads, residences, channels and water supplies. There are extensive agricultural areas in the subbasin that are affected by the loss of soils; damage to crops, machinery, and facilities; and flooding of residences. Additional costs are incurred as the result of moving livestock, countering weed seed infestation, and removing debris. Lost production time and delays in planting present serious problems because of the relatively short growing season.

The towns of the subbasin function primarily as agricultural service centers, and their economics are thereby affected by reduced yields caused by flooding problems in the rural areas.

Cultural

Twenty-one archeological sites and 20 historical sites have been identified within the subbasin. Most of the inventoried archeological sites have Woodland cultural components; two of these sites are representative

examples of the Arvilla Complex. Only one of the 20 recorded historical sites is presently listed on the National Register of Historic Places. Approximately one-third of the study area has not yet been systematically surveyed; hence, a more complete identification of significant cultural resources is not possible at this time.

Soils

Many soils in the subbasin are farmed intensively, although some are unsuited to cultivation. Fargo clay and Fargo silty clay, located in the western section, are two of the most prominent soils. Although intensively cultivated, both types have a high moisture-holding capacity that requires extensive ditching to remove storm runoff. Crop damage sometimes results because of the heavy texture of the surface and subsurface soils. This texture causes reduced drainage, both on the surface and through the soil. Located largely in the central western portion, Bearden loam and silt loam are easily tillible under a wide range of conditions; drainage is fair, with some ditching required. Members of the Bearden group provide a good seed bed and are intensively cultivated, although characteristics of the group include a high lime content and a low moisture-holding capacity that results in rapid drying. The shoreline area contains Ulen loamy sand, which consists of yellowish-brown sand with a low moisture-holding capacity that is susceptible to drought. Much of the area is cultivated, but wind erosion is a common problem. A high lime content is present is Barnes loam and silt loam, but both types have adequate surface drainage and are cultivated.

Water

In addition to the Wild Rice, Marsh, and South Branch Wild Rice rivers, the subbasin has numerous small lakes. The lakes are located mainly in the eastern half of the subbasin. Along with the rivers, they occupy 2.4 percent of the land area. The water resources of the subbasin are important for recreation, water supply, and fish and wildlife.

Woodlands

The woodlands and bushy areas of the subbasin are considered significant because they contain a greater variety of wildlife than any other major

habitat type. The Minnestoa Land Management Information Service provided data which shows that of the 1,296,720 acres in the subbasin, about 275,640 are forested. Comparison of the woodland percentages in each county included by the subbasin for 1969 and 1977 and percent increase or decrease is presented in Table 10. The data show that with one exception, Mahnomen County, the counties included by the subbasin demonstrated increases in woodland vegetation. These increases are probably caused by increased numbers of planted shelter belts and windbreakers and reestablishment of vegetation in the lower reaches of streams where flooding has prevented cultivation of agrucultural crops (U.S. Fish and Wildlife Service, 1980).

Table 10

COMPARISON OF COUNTY PERCENTAGES OF WOODLAND VEGETATION BETWEEN 1969 AND 1977

	Percentage of County Containing Woodland Vegetation		
County	1969	1977	Change in Percent Composition
Polk	5.1	6.7	+1.6
Norman	4.6	5.1	+0.5
Mahnomen	33.4	32.5	-0.9
Clay	2.8	3.0	+0.2
Clearwater	60.2	61.9	+1.7
Becker	40.6	46.5	+5.9

Source: Minnesota Land Management Information Service (in U.S. Fish and Wildlife Service, 1980).

Wetlands

Wetlands are important because of their many functional values such as habitats for plants and animals, flood control, waterfowl production, nutrient entrapment, groundwater recharge, etc. Additionally, in the

Clearwater County portion of the subbasin, Wild Rice wetlands are of commercial importance (Minnesota Water Resources Board, no date). Data provided by the Minnesota Land Management Information Service indicated that about 16,000 acres of marshes are found within the subbasin; this represents about one percent of the total area. Table 11 gives 1964 wetland data for Types 1, 3, 4, and 5 wetlands in Polk, Mahnomen, Clay, and Becker Counties, Minnesota. No wetland data were obtained for Clearwater and Norman counties. The 1964 inventory data represents a 25 percent sampling, and all numbers have been multiplied by 4 to achieve 100 percent values with the exception of Type 1. Type 1 wetlands were not inventoried in the 1964 survey, but previous studies have indicated that they comprise about 10-15 percent of total wetland acres and 60 percent of total wetland numbers in the Prairie Pothole Region. This information was used to calculate Type 1 estimates. The 1964 inventory data (expanded to 100 percent) is considered a conservative estimate (U.S. Fish and Wildlife Service, 1980).

Table 12 shows wetland numbers and acreages for 1974; this sampling represented a 100 percent inventory. In addition to the wetland types surveyed in the 1964 investigation, exclusive of Type 1 wetlands, Types 6 and 7 and stockponds are included as is information for Norman County. Table 13 shows a comparison of the 1964 and 1974 wetland inventory data for Types 1, 4, and 5. There data are comparable, since methods used in the 1974 survey allowed direct comparison of the same sampling locations at the 25 percent level sampling. These data show that wetland numbers and acreages within these five counties were reduced by 3,095 and 8,828 acres, respectively, during the 10-year period from 1964 to 1974.

Waterfowl Production Areas

Numerous Federal Waterfowl Production Areas (WPA's) are located within the subbasin. These are wetland areas that the U.S. Fish and Wildlife Service (USFWS) has either acquired through fee title or obtained an easement interest on to preserve valuable breeding, nesting, and feeding habitat for migratory waterfowl. These wetland areas are purchased, or an easement interest obtained, with funds received from the sale of Migratory Bird Hunting and Conservation Stamps ("Duck Stamps"). These WPA's are significant

Table 11

1964 WETLAND INVENTORY DATA FOR FOUR OF THE SIX COUNTIES
IN THE WILD RICE-MARSH RIVERS SUBBASIN

	Wetland Types[a]									
	1		3		4		5		Total	
County	Number[b]	Acres[c]	Number	Acres	Number	Acres	Number	Acres	Number	Acres
Polk	1,721	2,718	2,097	5,340	537	5,251	234	7,526	4,589	20,835
Mahnomen	1,848	2,319	2,776	10,975	186	1,973	118	2,509	4,928	17,776
Clay	1,574	1,411	1,881	3,687	567	3,548	176	2,169	4,198	10,815
Becker	1,207	1,332	1,748	5,174	180	2,779	84	924	3,219	10,209
Total	6,350	7,780	8,502	25,176	1,470	13,551	612	13,128	16,934	59,635

[a]Type 1-Seasonally flooded basins or flats
Type 3-Shallow fresh marshes
Type 4-Deep fresh marshes
Type 5-Open fresh water

[b]Calculated at 60% of total wetland numbers.

[c]Calculated at 15% of total wetland acres.

Source: U.S. Fish and Wildlife Service, 1980.

Table 12

1974 WETLAND INVENTORY DATA FOR FIVE OF THE SIX COUNTIES IN THE WILD RICE-MARSH RIVERS SUBBASIN

	WETLAND TYPE													
	3		4		5		6		7		Stock Ponds		Total	
County	Number	Acres	Number	Acres	Number	Acres	Number	Acres	Number	Acres	Number	Acres	Number	Acres
Polk	1,432	8,413	438	4,138	351	15,745	416	4,277	4	40	146	--	2,787	32,613
Norman	389	2,158	177	1,636	4	34	50	1,610	1	100	21	2	642	5,540
Mahnomen	1,504	9,919	261	5,054	130	9,206	46	477	2	25	144	--	2,087	24,681
Clay	1,299	7,338	311	3,671	158	5,652	393	7,249	61	673	165	--	2,387	24,583
Becker	1,688	15,520	210	9,700	103	12,843	87	1,935	--	--	37	--	2,125	39,998
Total	6,312	43,348	1,397	24,199	746	43,480	992	15,548	68	838	513	2	10,028	127,415

Source: U.S. Fish and Wildlife Services, 1980.

Table 13

COMPARISON OF 1964[a] AND 1974 WETLAND INVENTORY SHOWING NUMBER, ACREAGE, AND PERCENT CHANGES FOR FOUR OF THE SIX COUNTIES IN THE WILD RICE-MARSH RIVERS SUBBASIN

	Wetland Types															
	3				4				5				Total			
County	Number	Percent	Acre	Percent	Number	Percent	Acre	Percent	Number	Percent	Acre	Percent	Number	Percent	Acre	Percent
Polk	-259	-12.4	+113	+2.1	-18	-3.4	-1392	-26.5	-20	-8.5	-179	-2.4	-297	-10.4	-1458	-8.0
Mahnomen	-830	-29.9	-3136	-28.6	-66	-35.5	+291	+14.7	-88	-74.6	-1596	-63.6	-984	-31.9	-4441	-28.7
Clay	-418	-22.2	+472	+12.8	-300	-52.9	-1154	-32.5	-60	-34.1	-400	-18.4	-778	-29.6	-1082	-11.5
Becker	-844	-48.3	-217	-4.2	-120	-66.7	-1246	-44.8	-72	-85.7	-384	-41.6	-1036	-51.5	-1847	-20.8
Total	-2351		-2768		-504		-3501		-240		-2559		-3095		-8828	

[a]Represents values multiplied to 100 percent from a 25 percent sample.

Source: U.S. Fish and Wildlife Service, 1980.

because they provide the public with a great variety of wildlife-oriented recreational opportunities as well as provide valuable habitat for migratory waterfowl and many other forms of wildlife. The USFWS is responsible for the compatibility determinations (uses) and the issuance or denial of permits involving these lands. The approximate locations of these WPA's (fee tracts) within the subbasin are shown in Figure IV. Total acreage of these WPA's (fee and easement) in Clay, Becker, and Mahnomen Counties are listed in Table 14.

Table 14

ACRES OF FEDERAL WATERFOWL PRODUCTION AREAS (FEE AND EASEMENT) IN THREE* OF SIX COUNTIES OF THE WILD RICE-MARSH RIVERS SUBBASIN

County	Fee (Acres)	Easement (Acres)	Total Acres
Clay	7,063	1,330	8,393
Becker	9,458	463	9,921
Mahnomen	4,520	4,262	8,782
TOTAL	21,041	6,055	27,096

*Norman, Polk, and Clearwater Counties have no WPAs within the subbasin.

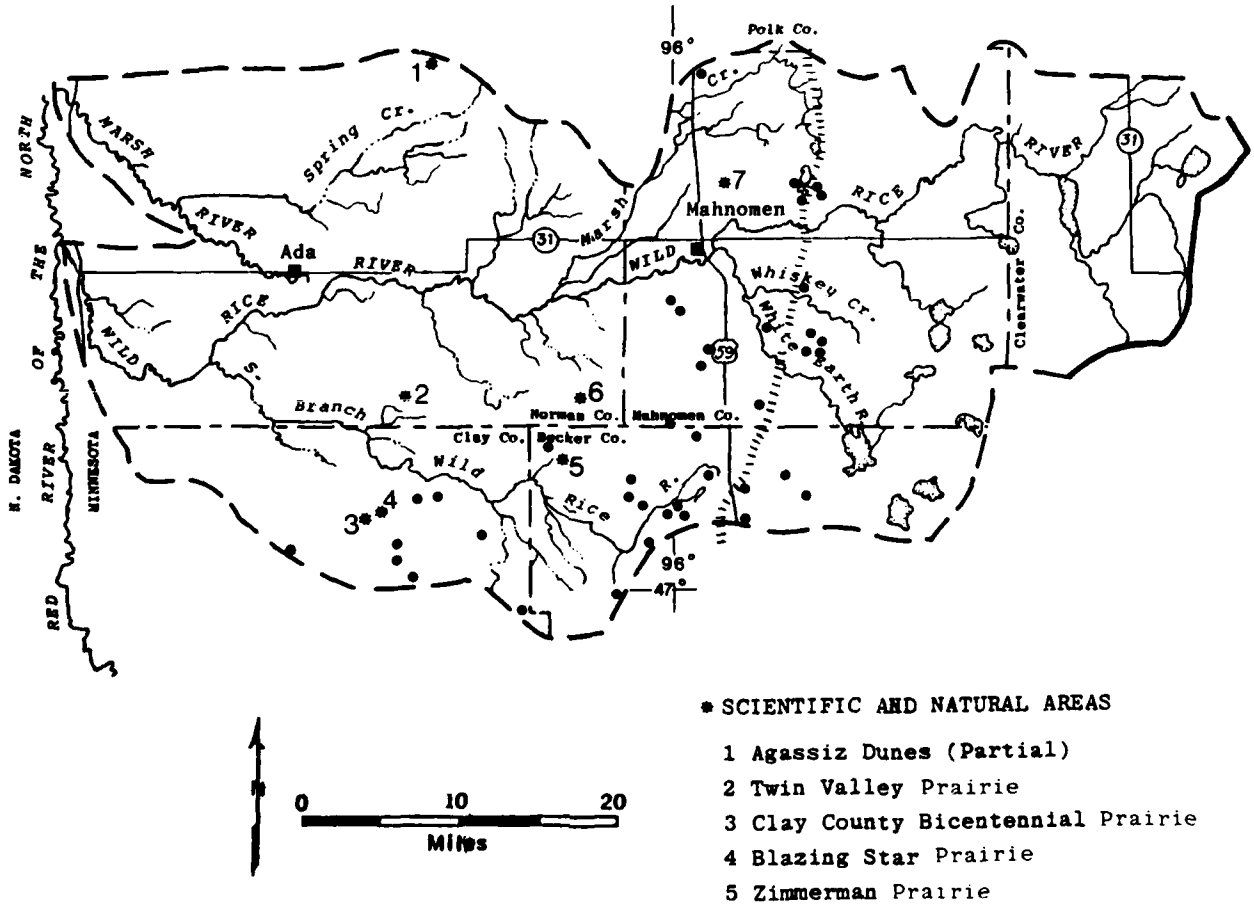
Source: Annual Report of Lands Under Control of the U.S. Fish and Wildlife Service as of September 30, 1978. U.S. Department of the Interior, Division of Realty, Washington, D.C.

Wildlife Management Areas

Wildlife Management areas are considered important because of the opportunities provided for outdoor recreation and the protection and management given to biological resources within their boundaries. A listing of the areas and their respective acreages and location was presented in the Existing Conditions section for recreation.

Threatened or Endangered Species

Threatened or endangered species occurring, or possibly found, in the subbasin are the bald eagle (threatened), and eastern timber wolf (threatened). The extreme eastern part of the subbasin may lie within



Source: The Nature Conservacy (no date); Miles and Yaeger (1979); U. S. Fish and Wildlife Service (1980).

Figure IV. WATERFOWL PRODUCTION AREAS AND SCIENTIFIC AND NATURAL AREAS

the primary range of the wolf, but the eastern part definitely encompasses the peripheral range, which includes Mahnomen County. The nesting range for the bald eagle embraces both Becker and Clearwater counties; there have been unconfirmed reports of breeding eagles in Mahnomen County that will be investigated this year. The Arctic peregrine falcon does not breed in the subbasin, but its wintering range is found throughout the region. In addition, the Dakota Skipper butterfly, a proposed endangered species is found in the remaining native prairies of Clay County, such as those that will be described later (U.S. Fish and Wildlife Service, 1979; McCabe and Post, 1977).

Other Important Species

The Minnesota Department of Natural Resources has identified certain plant and animal species in need of special consideration, those of special interest, and priority species.

Those species in need of special consideration include the following: (1) burrowing owl, greater sandhill crane, and greater prairie chicken--threatened; (2) eastern timber wolf, northern bald eagle, marsh hawk, and Franklin's gull--changing or uncertain status; (3) bobcat, pileated woodpecker, snapping turtle, ginsing, showy ladyslipper, little white ladyslipper, and Turk's-cap lily--special interest (U.S. Fish and Wildlife Service, 1980; Moyle, 1974). The burrowing owl may occur in the prairie remnants of the subbasin, and the greater sandhill was reported from the subbasin in Becker and Mahnomen counties during a 1977-78 survey. The greater prairie chicken is primarily restricted to the remnant prairie tracts in the Lake Agassiz beachline area of the subbasin. The wolf and eagle were described earlier under Threatened or Endangered Species. The Franklin's gull utilizes a colonial bird nesting site in the Felton-Ulen area. Both the pileated woodpecker and marsh hawk are known to breed in the region that includes the subbasin. Bobcats inhabit both Clearwater and Becker counties, where a total of 4 and 3 animals, respectively, were harvested in the 1978-79 season. The snapping turtle has been reported from the Wild Rice Watershed. Ginsing occurs in Becker County undisturbed. Mature hardwood forests occur in Polk, Clearwater, and Becker counties, as does the showy ladyslipper, which can be found in moist forests and

semi-marshy areas. The little white ladyslipper is a rare plant of alkaline marshes and swales in the prairie region and has been reported from Mahnomen and Clay counties. The Turk's-cap lily, occurring in Becker County, is found most frequently in moist, fertile soils of damp meadows, prairie swales, and damp depressions along roads (Henderson, 1978, 1979; Mann, 1979; U.S. Army Corps of Engineers, 1975; U.S. Fish and Wildlife Service, 1980).

The smooth green snake (two subspecies), Canadian toad, and Great Plains toad are species of special interest occurring in the counties of the subbasin. The smooth green snake is restricted to certain habitats limited in occurrence such as moist areas in prairie grasslands. The two toads are peripheral species in that they are western amphibians found on the eastern limits of their range in the subbasin (Henderson, 1979; Conant, 1975).

Mammals that have been designated as priority species by Henderson (1979) and Henderson and Reitter (1979) include Keen's little brown bat (Clearwater County), big brown Bat (Clearwater County), least weasel (Clearwater County), long-tailed weasel (Becker, Polk, and Clearwater counties), spotted skunk (Polk County), northern flying squirrel (Clearwater County), plains pocket mouse (Polk and Clearwater counties), and northern grasshopper mouse (Clay County). The big brown bat and grasshopper mouse have unique habitat requirements, and the Keen's bat and least weasel are rare or uncommon throughout their range in the state. Both numbers and range of the spotted skunk have declined significantly. The plains pocket mouse is known only from the northwest region (Region 1N) of the state. Reports are needed for both the flying squirrel and long-tailed weasel.

Natural Areas

Natural Areas are lands that are highly valued because they contain significant geologic or archeologic features, relatively undisturbed biotic communities, or provide other aesthetic features. Seven natural areas (Figure IV) have been designated within the subbasin: (1) Agassiz Dunes; (2) Twin Valley Prairie; (3) Clay County Prairie; (4) Blazing Star Prairie; (5) Zimmerman Prairie; (6) Frenchman's Bluff; and (7) Santee Prairie.

Only a small portion of Agassiz Dunes is located within the subbasin. The majority is located in the Sand Hill River Subbasin. This natural area contains a "fossil shoreline" of the Glacial Lake Agassiz as well as a transition zone of prairie and forest plant communities. This border also merges eastern and western animal species such as the small pocket gopher, prairie toad, western kingbird, upland plover, and lark sparrow (The Nature Conservancy, no date). The total acreage of Agassiz Dunes is 417 acres.

The Twin Valley Prairie lies wholly within the subbasin and comprises a 240-acre remnant of Tall Grass Prairie. This natural area is also situated along the beach ridge of Glacial Lake Agassiz. The prairie is inhabited by the prairie chicken, greater sandhill crane, little white ladyslipper, and Dakota Skipper butterfly (The Nature Conservancy, no date). All of these have been designated as being in need of special consideration. The Dakota Skipper butterfly is a proposed endangerned species (U.S. Fish and Wildlife Service, 1979, 1980).

The Clay County Bicentennial Prairie is located in northeastern Clay County and encompasses 160 acres. This area is along the highest beach ridge of Lake Agassiz. The plant community is that of a remnant tall grass prairie and supports a limited population of prairie chickens.

The Blazing Star Prairie is located in the opposite quarter section from that of the Clay County Bicentennial prairie. Therefore, the same plant and animal species are found in each. Within a two-mile radius of the Blazing Star Prairie, four booming grounds have been established.

The Zimmerman Prairie is a small (80 acres) remnant of the tall grass prairie located about four miles northeast of Ulen (Becker County). The area is a virgin prairie surrounded by extensive agricultural lands. Several "mima mounds", which are thought to have been created by the plains pocket gopher, are also located at the site (The Nature Conservancy, no date).

Situated on a gravely moraine about two miles northwest of Flom (Norman County) is another Natural Area, Frenchman's Bluff. This area has an excellent view of the Red River Valley and containts "one of the finest dry grass prairies in Minnesota". Unfortunately, the area is only 42½ acres (The Nature Conservancy, no date).

The other natural area in the subbasin is the Santee Prairie. This is a 448-acre wet prairie located in Mahnomen County. The area contains numerous potholes that are essential for waterfowl production. Santee Prairie also privides valuable habitat for prairie chickens, marsh hawks, and white-tailed deer. The Santee Prairie is also significant because it is adjacent to existing state wildlife lands (The Nature Conservancy, no date).

V. FUTURE CONDITIONS

V. FUTURE CONDITIONS

The following is a description of the subbasin's future economic, social, and environmental conditions and resources. This description is presented in terms of "most probable" and "without project" conditions.

Most Probable Economic Conditions

The two principal component counties of this subbasin, Norman and Mahnomen, are expected by the Minnesota State Planning Agency (MSPA) to briefly stabilize in population and to renew their population loss trends close to the end of the century. Portions of Clay, Becker, and Clearwater counties, which comprise the remainder of the subbasin, are expected by the MSPA to experience modest population gains that will offset the expected declines in Norman and Mahnomen. This will result in a seven percent per decade increase in population. These data along with employment and per capita income estimates throughout the study period (1980-2030) are presented below in Table 15.

The figures in the table were adopted in lieu of the prescribed OBERS E projections, because those projections appear to underestimate growth patterns for the Fargo-Moorhead area, both metropolitan and environs. Steady declines through the year 2020 are anticipated by this series. OBERS E and E' projections were, however, designated as the most probable for per capita income and agricultural activity estimates.

Farming will continue to be the economic mainstay of the subbasin, with communities such as Ada and, to a lesser extent, Mahnomen as service and retail centers for the large agricultural base. The Fargo-Moorhead area, 45 miles from the subbasin, will continue to serve as the primary retail and wholesale center. Local leaders and area planners point to the possible inundation of some 70,000 flood-prone acres and the towns of Ada, Mahnomen, and Hendrum as the biggest obstacles to economic growth.

Most Probable Agricultural Conditions

Roughly 836,000 acres within the subbasin are currenlty under cultivation, with wheat, barley, sunflowers, and oats as the principal crops. The

Table 15

WILD RICE-MARSH RIVERS SUBBASIN, POPULATION, EMPLOYMENT, AND PER CAPITA INCOME PROJECTIONS, 1980-2030

Parameter	1970	1977	1980	1990	2000	2010	2020	2030
Population	20,581	21,460	22,000	23,500	24,000	25,000	26,100	27,200
Employment	7,821	9,872	9,900	10,500	10,800	11,250	11,700	12,200
Per Capita Income ($)	$ 4,581	$ 6,892	$ 9,300	$12,600	$17,000	$22,900	$30,900	$41,700

Sources: U.S. Water Resources Council, 1972 OBERS Projections, Series E; Minnesota State Planning Agency; and Gulf South Research Institute.

estimated value of production in 1980 of these principal crops, using October 1979 Current Normalized Prices for Minnesota, is $56.9 million. Projections of total production through 2030 for the principal crops grown in the subbasin are presented in Table 16. The projected total production for 2030 represents a value of $95.6 million using October 1979 Current Normalized Prices for Minnesota.

Table 16

WILD RICE-MARSH RIVERS SUBBASIN, PRINCIPAL CROPS AND PROJECTED PRODUCTION, 1980-2030
(Production in Thousands)

	Crop			
Year	Wheat (Bushels)	Barley (Bushels)	Sunflowers (Pounds)	Oats (Bushels)
1980	7,555	7,423	160,400	4,285
1990	8,763	8,611	186,100	4,971
2000	9,973	9,798	211,700	5,656
2010	10,728	10,541	227,800	6,085
2020	11,483	11,283	243,800	6,513
2030	12,692	12,471	269,500	7,199

Sources: OBERS Series E; and Gulf South Research Institute.

Evaluation of Flood Damages--Future Conditions

A summary of present and future average annual flood damages is presented in Table 17. Assuming a discount rate of 7 1/8 percent, average annual damages throughout the projection period are expected to be $2,602,900, of which 84 percent is agricultural damages.

Flood damages to residences, businesses, industrial structures, churches, schools, automobiles, house trailers, public property, and contents are included in the urban damages category. Damages to streets and utilities (including water, gas, electricity, sanitary sewers, storm sewers, and telephone systems) are also taken into consideration. This category also includes loss of wages, loss of profits, expenditures for temporary housing, cleanup costs, and extra expenses for additional fire and police protection and flood relief.

Table 17

WILD RICE-MARSH RIVERS SUBBASIN, SUMMARY OF PRESENT AND FUTURE AVERAGE ANNUAL DAMAGES, URBAN, AGRICULTURAL, AND TRANSPORTATION
(October, 1979 Prices, 7 1/8 Percent Interest)

	Flood Damages									
Category	1980	1990	2000	2010	2020	2030	Increase 1980-2030	Average Annual Equivalency Factor	Average Annual Equivalency of Increase	Equivalent Average Annual Damages
Urban										
Ada	$ 200,000	$ 220,000	$ 240,000	$ 260,000	$ 280,000	$ 300,000	$ 100,000	0.2903	$ 29,000	$ 229,000
Hendrum	50,000	55,000	60,000	65,000	70,000	75,000	25,000	0.2903	7,300	57,300
Agricultural										
Crop	1,294,600	1,501,700	1,708,900	1,838,300	1,967,800	2,174,900	880,300	0.2903	255,600	1,805,800
Other Agricultural	338,100	365,100	392,200	409,100	426,000	453,100	115,000	0.2903	33,400	371,500
Transportation	139,300	139,300	139,300	139,300	139,300	139,300	--	--	--	139,300
TOTAL	2,022,000	2,281,100	2,540,400	2,711,700	2,883,100	3,142,300	1,120,300	0.2903	325,300	2,602,900

Source: Gulf South Research Institute.

Agricultural flood damages consist of crop and pasture damage, which may include costs of replanting, refertilizing, additional spraying, reduced crop yields, loss of animal pasture days, and other related flood losses.

Other agricultural damages consist of land damage from scour and gully erosion and deposition of flood debris; livestock and poultry losses; damages to machinery and equipment, fences, and farm buildings and contents (excluding residences); and damages to irrigation and drainage facilities.

Transportation damages include all damages to railroads, highways, roads, airports, bridges, culverts, and waterways not included in urban damages. In addition, all added operational costs for railroads and airlines and vehicle detours are included.

Future growth of urban flood damages was estimated to be an uncompounded (straight-line) rate of one percent per year for a 50-year period beginning in the base year, with no growth thereafter.

Agricultural crop flood damages were projected to increase at the same rate as crop income projections published in the 1972 OBERS Series E projection report. These crop income projections were prepared by the U.S. Economic Research Service (ERS) for the Red River of the North region. Other agricultural flood damages were projected to increase at one-half of this rate.

Transportation damages are not expected to change throughout the project life because of the long-term economic life associated with such structures as bridges, railways, roads, and culverts. In addition, it has been found that repairs to these types of structures rarely exceed the cost of a new structure, even with frequent flooding.

Most Probable Environmental Conditions

Water quality improvements in the subbasin should occur as adequate treatment measures are achieved by all point sources. Conditions should also improve with implementation of nonpoint source or 208 plans. However, it will take considerably longer for the nonpoint sources to rectify pollution problems. Violations of the dissolved oxygen parameter are expected to continue during winter months when the ice cover inhibits reaeration in the streams.

Barring changes in land use trends noted from 1969 to 1977, woodland wildlife habitats will increase. Comparison of inventory data between 1964 and 1974 indicates that wetlands will continue to decline in both number and areal extent, resulting in decreases in floral and faunal populations using these valuable habitats either wholly or in part. Improvements in water quality will cause commensurate improvements in habitats for aquatic biota. Low flows in late summer and dry periods of the year will continue to favor those species that can adapt to these conditions.

Without Project Conditions

In the abscence of a plan to alter resource management procedures, it is anticipated that the conditions that will prevail between 1980 and 2030 will be the same as those described as being the most probable.

VI. EXISTING FLOODPLAIN MANAGEMENT PROGRAMS

VI. EXISTING FLOODPLAIN MANAGEMENT PROGRAMS

Institutions

The development of effective water resources management practices in the subbasin is affected by the large number of Federal, state, and local agencies involved in project planning and implementation. There are 44 Federal agencies with various types of jurisdiction, and 14 directly involved in the water and related land resource planning process. At the state level, 27 agencies are involved. There are also regional commissions, county agencies, and municipal entities. Differences in perspective and problems of coordination hamper the effective and speedy resolution of problems.

In 1972, the boundaries of the Wild Rice-Marsh River Drainage and Conservancy District were enlarged, and the name was changed to the Wild Rice Watershed District. The district deals with flooding, erosion, reclamation, drainage, water supply, waste disposal and other problems related to water resources management. An overall plan for the watershed has been developed.

The major Federal agencies with water resource development interests in the area are the Soil Conservation Service (SCS) and the St. Paul District Corps of Engineers. There are six soil and water conservation districts (SWCDs) with authority in the subbasin, including the Becker, Clay, Clearwater, Mahnomen, East Agassiz, (Norman County) and West Park districts. The Corps of Engineers, the SCS, and the watershed district have implemented various flood control measures within the subbasin.

The Corps of Engineers, SCS, the various soil and water conservation districts (particularly the East Agassiz and Mahnomen districts), the watershed district, and the towns affected by flooding should be taken into consideration in flood control planning for the subbasin. In addition, the White Earth Indian Reservation Tribal Council and the Bureau of Indian Affairs have jurisdiction over measures constructed on reservation lands in Mahnomen County and parts of Clearwater and Becker counties. It should also be mentioned that the Northwest, Headwaters, and West Central regional development districts have each developed an overall economic development plan that includes portions of the subbasin.

Structural Measures

A diversion channel was constructed near Ada in 1895 by the Red River Drainage Commission. This channel, about 9.8 miles in length, diverts part of the high flows from the Wild Rice River into the Marsh River. In 1906, the Minnesota State Drainage Commission dredged a series of cutoffs on the Wild Rice River between miles 35 and 40 in the interest of flood control.

The flood control measures have been completed by the U.S. Army Corps of Engineers. In 1954, the Corps completed 38.9 miles of channel improvements, consisting of: (1) enlarging, straightening, and clearing of 14.9 miles of the Wild Rice River above mile 27.3; (2) clearing of the Marsh River and Marsh River Diversion Channel for 24 miles above mile 20.8, except between river miles 31.7 and 34.8, where the channel was enlarged and straightened; (3) and construction of a dike and grated culvert on the right bank of the Wild Rice River at mile 41.7 to permit diversion of limited flows through an old channel of the Marsh River for water quality control at Ada. In addition, in 1964 the Corps completed snagging and clearing of a 12-mile reach of the Wild Rice River between miles 15.2 and 27.2.

Local interests with the cooperation of the Soil Conservation Service have a project under construction in the Norman-Polk Watershed, which is located in the northwest sector of the subbasin. This project includes non-structural, land treatment measures for 28,770 acres and structural measures consisting of 28 miles of channel work and six stabilization structures. Construction of this project is phased over a six-year period, with completion scheduled for 1984. Upon completion, these measures will reduce average annual damages from flooding in the watershed by 77 percent and will provide protection from a 20 percent (five-year) flood frequency.

The Corps of Engineers has an authorized flood control project for the South Branch Wild Rice River and Felton Ditch consisting of 17.2 miles of channel improvements along the South Branch Wild Rice River and 17.7 miles of channel improvements and 2.4 miles of levee work along Felton Ditch. This project will reduce the rural flood losses by 88 percent in the South Branch and Felton Ditch watersheds and will provide protection

against a six percent (16.7-year) flood frequency. Funds have been appropriated for this project, and bids should be received for construction sometime in 1980.

In addition, the Corps of Engineers has been authorized to provide emergency bank protection at Mahnomen under Section 14 of the 1946 Flood Control Act. The proposed plan of improvement consists of placing quarry-run stone protection along approximately 400 feet of the north (right) bank of the Wild Rice River. Construction of this project is scheduled for the latter part of 1980.

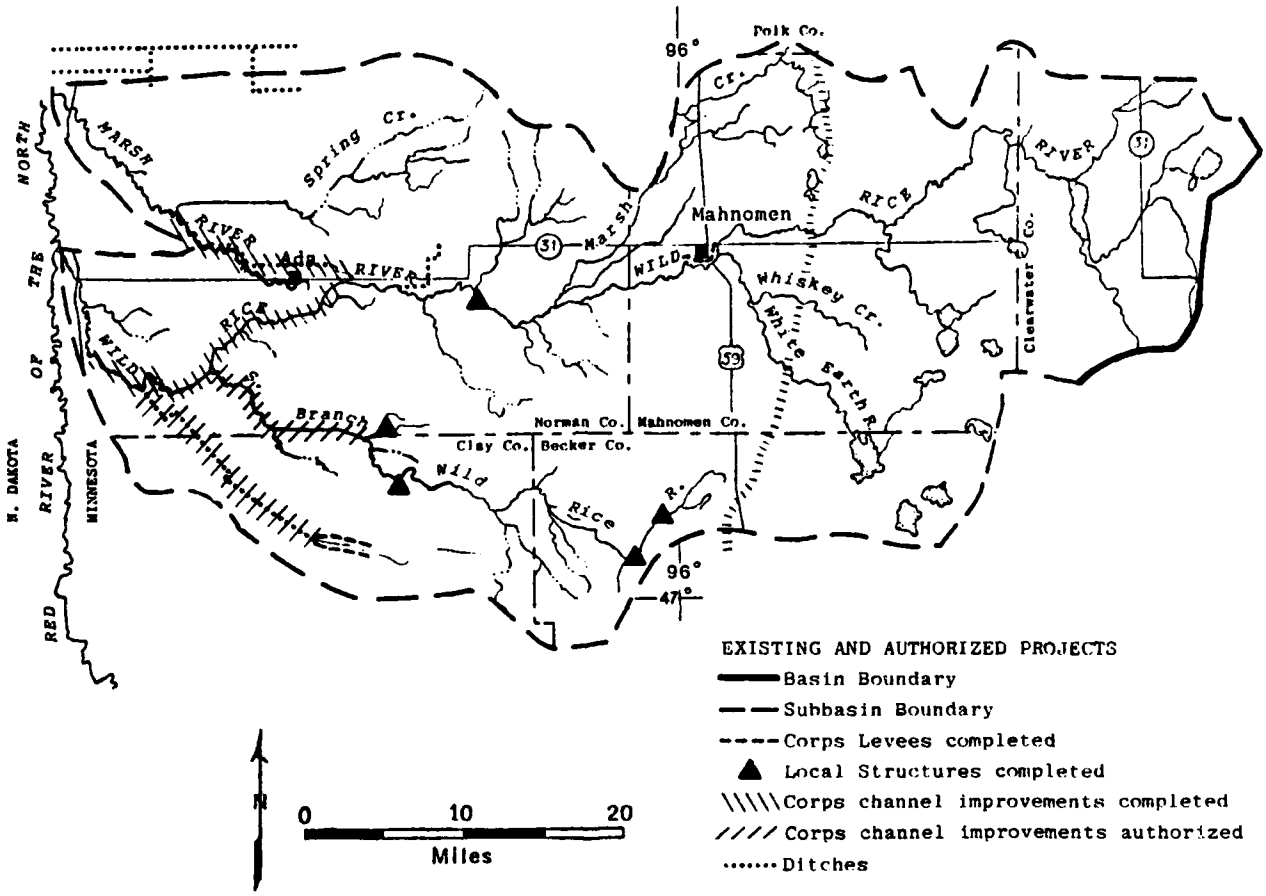
Under the auspices of the Wild Rice Watershed District, several measures have been constructed to lessen flood damages. These include five dam and retention structures and numerous channel improvements. Most of these measures were undertaken to aid selected areas and have no significant effect on the major flood problems in the subbasin.

Locations of the various flood reduction measures, both completed and authorized, are displayed in Figure V.

Nonstructural Measures

Nonstructural flood control measures are measures that reduce or eliminate flood damages through procedures that involve little, if any, construction efforts. The major types are flood warning, floodplain zoning, flood insurance, flood proofing, and floodplain evacuation. These measures are primarily applicable to urban areas. Urban flood damages in the subbasin are substantial, and numerous nonstructural measures have been instituted, including:

1. Flood insurance in Mahnomen County.
2. Flood insurance and floodplain zoning ordinances in Becker, Clearwater, and Norman counties.
3. Flood insurance, floodplain zoning ordinances, and subdivision regulations for floodplain areas in Clay County.
4. Flood insurance in Ada, Felton, Mahnomen, and Shelly.
5. Flood insurance, floodplain zoning ordinances, and subdivision regulations for floodplain areas at Hendrum.



Source: Gulf South Research Institute.

Figure V. EXISTING FLOOD CONTROL MEASURES

All of the towns in the subbasin participate in the Red River Valley flood warning system. The flood warning system for the Red River Valley is a cooperative network organized by the National Weather Service in Fargo, North Dakota. Fifty volunteers throughout the basin report to the National Weather Service on a weekly basis during winter and fall and on a daily basis during spring and summer. The reportage covers all precipitation of 0.1 inch or more, including amount of snow and water equivalent. This information is transmitted to the River Forecast Center in Minneapolis, where it is run through a computer system to determine probable flood stages. The predictions are then transmitted to the National Weather Service in Fargo, which releases them to the public through the news media. Communities are then able to engage in emergency actions to protect themselves from flood damages. Contacts with local officials indicate that the flood warning system generally works quite well in the subbasin.

There are other types of measures that could be used in the subbasin to reduce flood damages but that are not directly applicable to urban areas. These measures would include such things as land treatment programs, use of present drainage ditches for floodwater storage, use of natural areas for water retention, and acquisition of previously drained natural areas for reversion to water retention use. Land treatment is used by some farmers in the subbasin, but the SCS has not been called upon to undertake a large-scale program. Present drainage ditches are not used for floodwater storage, and no plans have been developed for future use. Information on natural storage areas and potentialities for increased storage is very limited. Indications are, however, that wetlands play a substantial role in controlling runoff, particularly in combination with good land treatment practices.

Adequacy of Existing Measures

The adequacy of existing projects was not evaluated during the development of this study because the Corps of Engineers has indicated that present and proposed projects should be satisfactory to control the major flood problems in the subbasin.

VII. CRITERIA AND PLANNING OBJECTIVES

VII. CRITERIA AND PLANNING OBJECTIVES

Floodplain Management Criteria

Technical, economic, and environmental criteria must be considered when formulating and evaluating alternative floodplain management measures for the subbasin.

The technical criteria used in formulating and evaluating alternatives for this report consisted of the application of appropriate engineering standards, regulations, and guidelines.

Economic criteria entailed the identification and comparison of benefits and costs of each measure. Tangible economic benefits must exceed costs; however, in certain instances, considerations of appropriate gains in the other accounts (environmental quality, social well-being and regional development) could alter this requirement. All alternatives considered are scaled to a design which optimizes benefits. Annual costs and benefits are based on an interest rate of 7 1/8 percent and price levels and conditions existing in October 1979. A 50-year amortization schedule is used for the features considered.

Environmental considerations call for the formulation of measures that minimize objectionable or adverse environmental effects and maximize environmental benefits. Also, limited consideration was given to modifications based on coordination with state and Federal agencies, local interests, and citizen groups.

Planning Objectives

The primary planning objective of this study was to contribute to flood reduction needs in the subbasin and thereby provide protection from or reduction of flood losses. In conjunction with this economic objective, the study attempted to develop contributions to the environmental quality of the subbasin.

The development of planning objectives involved a broad-range analysis of the needs, opportunities, concerns, and constraints of the subbasin from the information available. On the basis of this analysis of identifiable problems, needs, and desires, the following planning objectives were established:

(1) Contribute to protection from and prevention, reduction, or compensation of flood losses for the flood prone areas of the subbasin during the period of analysis.

(2) Contribute, to the maximum extent possible, to the preservation of the quality of the existing riverine environment and enchance the environmental potential of the subbasin as a whole.

(3) Contribute to the enhancement of recreational opportunities throughout the subbasin, but particularly in the western portion.

(4) Contribute to the improvement of water quality in the lakes and in the Wild Rice-Marsh rivers and creeks of the subbasin.

(5) Contribute to the improvement of water supply in the western portion of the subbasin.

(6) Contribute to the reduction of wind and water erosion throughout the subbasin.

(7) Contribute to the developing trend toward increased irrigation throughout the subbasin by investigating the surficial sand aquifers.

(8) Contribute to the reduction of wastewater management problems, particularly insofar as they relate water to quality.

VIII. FORMULATION OF ALTERNATIVE MEASURES

VIII. FORMULATION OF ALTERNATIVE MEASURES

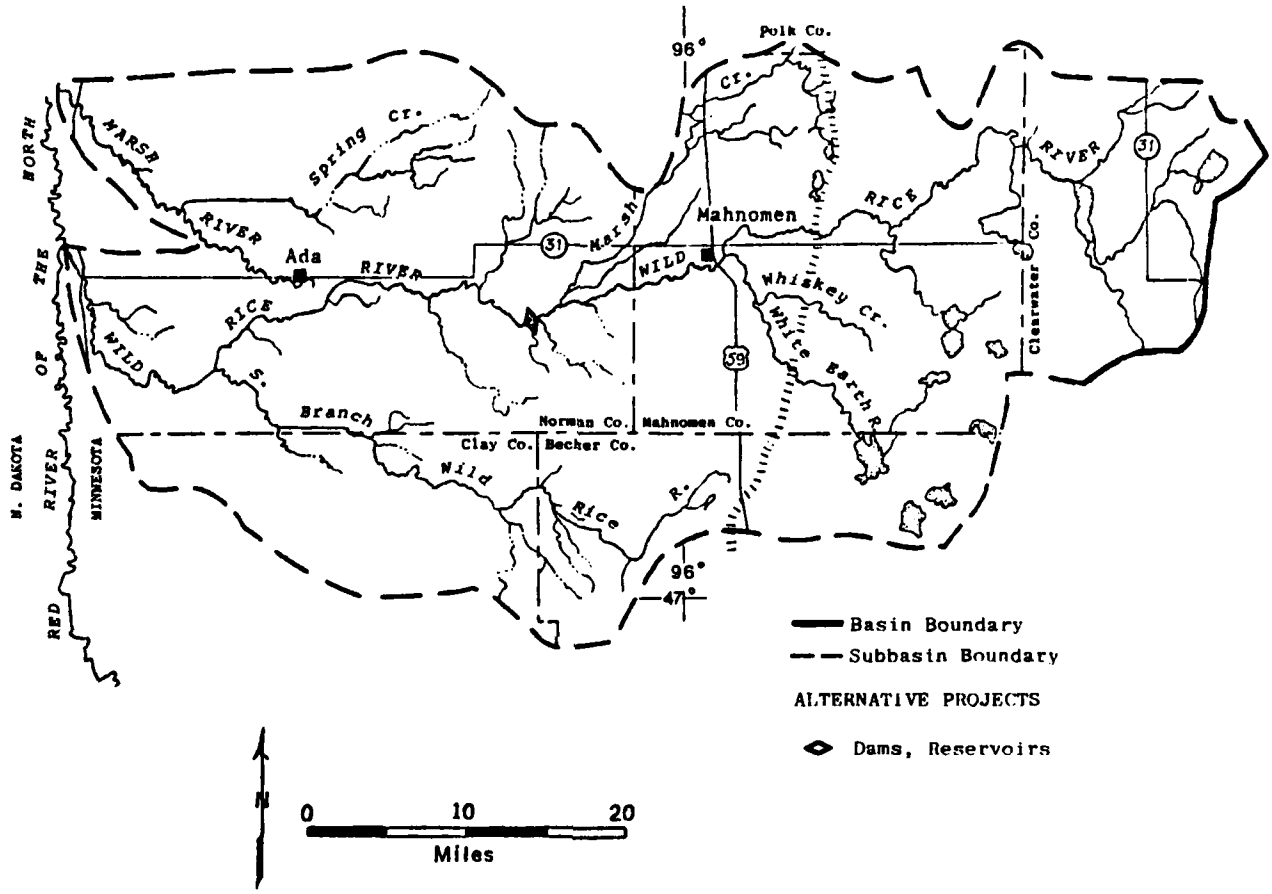
This section contains a discussion of the management measures that have been identified to meet the resource management objectives. Prime consideration is given to the resolution of flooding problems. Measures to meet the other planning objectives were considered exclusively as components of flood control measures.

Under the scope of work for this study, it was assumed that present and planned flood control measures identified in existing planning documents would be sufficient to solve the flooding problems of the subbasin. Therefore, the following discussion is limited to a representation of previously identified measures and ongoing flood control programs. However, price levels for the measures have been updated to determine their current viability.

1. Studies by the Corps of Engineers show that a dam on the Wild Rice River east of Twin Valley is a viable alternative (Figure VI). The dam would be constructed of earth and would have a height of about 85 feet and a crest length of over 4,000 feet, including the spillway. Total storage capacity of this facility would be 52,200 acre-feet, of which 44,700 acre-feet is allocated for flood control storage, which could control about a 77-year frequency flood at Twin Valley. Flood damages in the subbasin would be reduced by 64 percent, and damages along the Red River of the North would be reduced by about five percent. This project has been authorized for construction but funds have not been allocated for this purpose. Such funds are dependent of new studies of this alternative.

2. The Wild Rice River Watershed District has several projects near the construction stage and others in the planning phase. These projects will provide flood protection for small isolated areas, but will not have a significant effect on Wild Rice or Marsh River floods. Since this study is concerned with flood control alternatives in which the Federal Government would have a construction interest, the measures devised by the watershed district are not illustrated in Figure VI.

3. The Souris-Red-Rainy River Basins Study (1972) sets forth flood damage reduction alternatives of 14,600 acre-feet of storage in multi-reservoir sites, 36 miles of channel improvements, and floodplain regulations for the towns of Ada and Mahnomen. Locations of the reservoirs and channel improvements were not identified; consequently, these measures are not shown in Figure VI. The measures



Source: Gulf South Research Institute.

Figure VI. ALTERNATIVE FLOOD CONTROL MEASURES

would provide protection for rural areas and existing urban developments against a 10 percent (10-year) frequency flood and for future urban developments against a 1.0 percent (100-year) frequency flood. The implementing agency would probably be the Soil Conservation Service.

4. Construction of levees around farmsteads of an estimated 5.0 acres in flood-prone areas would provide protection against a 1.0 percent (100-year) frequency flood. These levees could be constructed by SCS, the Corps, or private individuals.

5. The Upper Mississippi River Basin Commission has initiated a study to determine the effect of present agricultural land drainage practices on flows of the Red River of the North and to help develop alternatives. The objective of this study is to utilize an existing hydrologic computer simulation model to quantify, to the extent possible, the effects of manmade surface drainage on Red River Main Stem flood stages. Two small areas that are representative of most areas in the Red River Basin have been selected for analysis: Marsh Creek Watershed and Rush River Watershed. The analysis will enable some general inferences to be made regarding aggregate basin-wide impacts.

With respect to nonstructural measures, floodplain regulations for the towns of Ada and Mahnomen were considered as part of the third measure discussed above. A full range of nonstructural alternatives was considered in connection with the proposed Twin Valley Lake project, including flood warning, floodplain evacuation, flood proofing, flood insurance, flooplain regulations, and combinations. It was found that these alternatives would provide only minor flood damage reductions and, in some cases, would be detrimental to economic development and social well being.

For those towns in which floodplain regulation is not in effect, this would be a viable alternative for limiting the growth of urban damages. However, in this, as in most subbasins, the primary damages are agricultural in nature and would not be affected by urban nonstructural measures. There is an opportunity for the use of land treatment measures throughout the subbasin that would help to contain water on land as well as reducing erosion damages. Natural retention areas should also be considered for preservation. However, these would need to be identified, and their retention capacities would need to be determined. In addition, there may also be opportunities for wetland restoration.

IX. ASSESSMENT OF ALTERNATIVES

IX. ASSESSMENT OF ALTERNATIVES

Economic Assessment

The effects of the flood control alternatives for the subbasin along with their costs and benefits are presented in Table 18. All measures were analyzed on the basis of information presented in prior studies. The drainage study for Marsh Creek was not evaluated because it is not project-oriented. Also, alternatives devised by the Watershed District were not evaluated because they do not fall under the authority of the Corps of Engineers.

For the measures that were evaluated, discharge frequency curves for the various stream reaches were correlated with discharge-area flooded curves and with the average annual acres flooded. The weighted average crop damage per acre flooded and other agricultural flood damages per acre multiplied by the average annual area flooded established total agricultural damages. Average annual transportation (road and bridge) damages were obtained from interviews with county officials concerning past floods. Average annual urban flood damage estimates were based on data from extensive field damage surveys following major floods. This discussion capsulizes the methodology used by the agencies that developed the flood control measures presented in Table 18.

Capital costs of the flood control measures were updated using October 1979 unit construction cost estimates. Average annual benefit figures were updated using the Gross National Product (GNP) implicit price deflators. Since Twin Valley Lake and the Souris-Red-Rainy report flood control measures were developed under previous interest rates (5 7/8 percent and 4 5/8 percent, respectively), the benefit-cost ratios developed in the present study are somewhat below the original figures. For further detail on these alternatives, see the February 1975 Twin Valley Lake Design Memorandum Number 2, Phase 1-Plan Formulation and the 1972 Souris-Red-Rainy River Basins Comprehensive Study, Volume 3 Appendixes D and E. The farmstead levee alternative was analyzed on a per-farm basis using private construction cost and benefit estimates prepared by the St. Paul District Corps of Engineers. In addition, analysis of the Twin Valley Lake alternative was supplemented by information provided by the Economics Section of the St. Paul District.

Table 18

ECONOMIC EVALUATION OF ALTERNATIVES

Alternatives	Acres Protected	Average Annual Acres	Capital Costs	Average Annual Costs	Average Annual Rural Benefits	Average Annual Urban Benefits	Average Annual Recreational Benefits	Total Average Annual Benefits	B/C Ratio
1. Twin Valley Lake	99,000	6,507	$27,735,700	$2,199,000	$1,130,600	$ 977,700*	$102,000	$2,210,300	1.01
2. Reservoirs and Channel Improvements	--	--	1,710,000	125,900	79,600	--	--	79,600**	0.63
3. Farmstead Levees	5	--	5,600	400	840	--	--	840	2.10

* Average annual urban benefits figure includes employment benefits.

**The Souris-Red-Rainy report also estimates $45,800 in average annual equivalent land enhancement benefits.

Source: Gulf South Research Institute.

Impact Assessment

Table 19 presents a generalized assessment of the effects on the resource elements that can be expected if the measures were to be implemented. The impacts of the proposed Twin Valley Lake reservoir project were obtained from the February 1975 Final Environmental Impact Statement, Twin Valley Lake Project, Wild Rice River, Minnesota and the January 1978 Fish and Wildlife Compensation Plan for the same project. Both documents were prepared by the St. Paul District.

Twin Valley Lake Reservoir

The proposed reservoir would have maximally beneficial economic effects because of the reduction of flood damages in the subbasin. Flood protection would be afforded to some 9,000 acres annually, with average annual flood protection, recreation, fish and wildlife, and area redevelopment benefits of approximately $2.2 million. This reduction of flood damages would occur mostly on agricultural lands downstream of Twin Valley, along the Marsh River and also along the Red River of the north downstream of its confluence with the Wild Rice River.

It is estimated that approximately 3,000 persons, 570 residences, 90 businesses, and 300 farmsteads would be afforded flood protection. Ten persons and four farmsteads would require relocation. Persons living in protected areas would experience less rural community disruption and fewer threats to public health and safety during flood periods. Those individuals owning a total of about 3,500 acres would have to sell property necessary for the project. Overall, social benefits were deemed to be maximally beneficial.

Making farming in the floodplain more profitable could well influence land use and agriculture. Total project land would encompass about 3,500 acres, of which 2,800 acres have native vegetation and 700 are agricultural. This along with more intensive use of existing lands and possible clearings for additional farming might well occur. The net effects from a land use standpoint would be minimally adverse.

Moderately adverse biological impacts would result from the proposed measure. The project would modify or destroy existing ecosystems of floodplain

Table 19

ASSESSMENT OF MEASURES, BY RESOURCE ELEMENT, WILD RICE-MARSH RIVERS SUBBASIN

Measures	Social	Economic	Land Use	Biology	Water Quality	Water Supply	Cultural	Recreation
Twin Valley Lake Reservoir	MaB	MaB	MiA	MoA	MiA	NKE	NKE	MaB
Reservoir and Channel Improvements	MoB	MoB	MiA	MiA	MiA	NKE	NKE	MiB
Farmstead Levees	MiB	MiB	NKE	NKE	NKE	NKE	NKE	NKE

Note: NKE-No Known Effect
MiA-Minimally Adverse
MoA-Moderately Adverse
MaA-Maximally Adverse
MiB-Minimally Beneficial
MoB-Moderately Beneficial
MaB-Maximally Beneficial

Source: Gulf South Research Institute.

forests, agricultural lands, and streambeds. Reduction and changes in habitat and disruption of ecological balances would affect vegetation and wildlife well beyond the limits of the design flood pool.

Water quality would also be affected negatively, although minimally. Turbidity and sedimentation would be affected by construction. The extent of the effect would depend on such factors as streamflow and rainfall at the time of construction. Although suspension of sediments in the water is temporary, the resultant siltation on downstream areas is permanent. The lake, however, would also trap sediments that would otherwise go to downstream reaches.

Although recreational enjoyment of upland hunting and river canoeing would be adversely affected, recreational effects were judged maximally beneficial because the 7,500 acre-foot pool would be reserved for recreation (as well as for conservation and silt retention).

Water supply would not be affected by the Twin Valley measures, nor would cultural resources. No known effects can be determined for project lands, borrow areas, etc.

Reservoir and Channel Improvements

Flood damage reduction measures that encompass 14,600 acre-feet of storage in multi-reservoir sites and 36 miles of channel improvements would have moderately beneficial social and economic effects in the subbasin. The benefits would accrue mostly from protection for rural areas and existing urban developments against a 10-year frequency flood and for future urban developments against a 100-year frequency flood. Recreation would be beneficially, although minimally, affected.

Minimally adverse effects would be experienced by land use elements as a result of the impoundments. A similar level of disruptive effects would occur to biological elements (because of the disruptions and changes in existing habitat) and to water quality (turbidity and sedimentation). It is not known how water supply and cultural elements would be affected.

Farmstead Levees

Minimally beneficial economic and social effects would result from the protection of several farmsteads in the 100-year floodplain. All other resource elements would not be significantly affected, although consideration must be given to public health and aesthetic factors prior to their construction.

X. EVALUATION

X. EVALUATION

Two alternative measures considered for the subbasin have benefit/cost ratios that exceed unity. They are Twin Valley Lake and the farmstead levees.

Twin Valley Lake would meet the flood protection needs of the subbasin and would best meet National Economic Development (NED) objectives according to the Design Memorandum prepared in 1975. Total project benefits are greater than costs, and substantial flood damage reductions would result. The social well-being (SWB) account would be enhanced by public health and safety improvements, flood damage reductions, and provision of additional water-based recreational opportunities. The Environmental Quality (EQ) account would receive basic changes, several of which are negative. In association with this same Design Memorandum, an EQ plan was considered. A levee floodway system that met the Basin's needs and EQ objectives was analyzed. The wooded corridor along the river would not only be preserved but would probably be enhanced by using this wide corridor for the passage of flood discharges. The economic aspects of this plan were judged unfavorable as were the social impacts of this relocation of about 35 residences and farmsteads.

The farmstead ring levees also exceed the above unity criteria but do not benefit the overall resolution of subbasin flooding problems. National Economic Development and Environmental Quality plans will be tentatively formulated in association with the Red River of the North Basin's main reconnaissance report.

AD-A140 694 WILD RICE-MARSH RIVERS SUBBASIN RED RIVER OF THE NORTH RECONNAISSANCE REPORT(U) GULF SOUTH RESEARCH INST BATON ROUGE LA DEC 80 DACW37-80-C-0017 2/2

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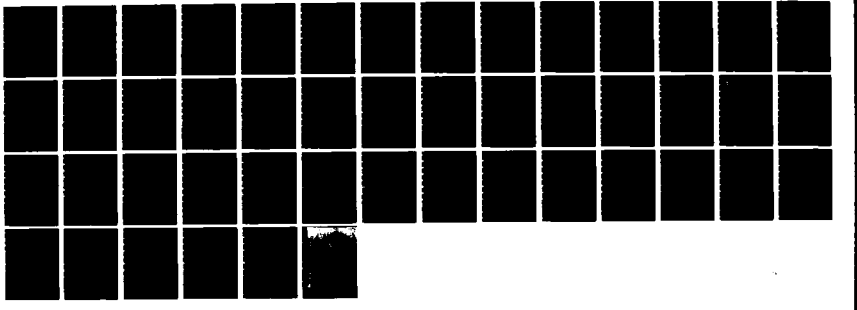

XI. ADDITIONAL STUDY NEEDS

XI. ADDITIONAL STUDY NEEDS

This report was developed almost entirely on the basis of secondary information from readily available planning documents. Data available from state and Federal agencies was not fully canvassed, and only a limited number of calls were made to the area. In particular, state university libraries and department resources could not be fully utilized. Thus, the document aims only at a broad-brush perspective. In order to provide a more detailed and in-depth analysis of subbasin resources, problems, and potential solution, the following additional study needs would have to be fulfilled:

1. A literature search should be conducted to obtain available biological data for the subbasin. Fieldwork should be planned to fill in any data gaps which exist with the end result of obtaining good baseline data for the subbasin.
2. Areas of high environmental quality (e.g., prairie remnants) should be identified and inventoried within the subbasin.
3. Knowledge of the location, areal extent, and types of wetlands occurring within the specific subbasin boundaries would be extremely useful in determining whether wetland restoration would assist in solving flooding problems, as has been indicated by Cernohous (1979).
4. Primary water and sediment quality data are needed, such as that available for the Wild Rice River at Twin Valley, to characterize baseline conditions in the streams of the subbasin.
5. Information on wastewater management needs to be updated.
6. The information obtained in items 1-5 above would provide an important data base upon which the cumulative impacts of flood control projects in the subbasin on environmental resources can be evaluated. These projects include those that are in-place, in the construction phase, and either authorized or planned for the subbasin.
7. The potentiality for land treatment measures (e.g., erosion control measures such as cover crops, green belts, reduction in fall tillage, etc.) need to be thoroughly investigated.
8. The people of the subbasin need to be included in further water resource planning efforts. A public involvement program would provide more complete information on water resource problems and opportunities than is presently available.

9. Studies are needed to determine additional demand for recreational facilities, usage of existing facilities, and potential sites.

10. A review of secondary sources and systematic field reconnaissance is needed to identify archaeological and historical sites.

11. A detailed social profile of the subbasin is needed.

12. A detailed institutional analysis of the subbasin is needed.

13. Subbasin boundaries need to be better defined on the basis of hydrologic conditions, and total acreage in the subbasin needs to be precisely measured.

14. An adequate 100-year floodplain map needs to be developed. Also, the extent of floodplains for smaller frequency storms needs to be delineated.

15. Land use within the floodplain needs to be precisely identified.

16. The irrigation potentials of the subbasin soils needs to be investigated.

17. The effect of wetland drainage on flood discharges and stages is unknown at present. It would take additional, more detailed studies to determine the extent and effect of reduced natural storage.

18. Potentialities for floodwater storage in present drainage ditches needs to be investigated.

19. Crop distribution in the floodplain needs to be precisely identified through contact with county agents, and average annual rural damages need to be updated.

20. Urban damages need to be recomputed in a systematic fashion.

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Appendix A
FLOODPLAIN DELINEATION

Appendix A
FLOODPLAIN DELINEATION

Prior to this study, no attempt was made to publish even a generalized delineation of the entire Wild Rice-Marsh rivers floodplain. In undertaking this task, the present study utilized all known sources to provide the best available data for generalized delineation at a scale of 1:250,000. Principal sources were: USGS Flood Prone Area Maps (scale 1:24,000), Federal Insurance Administration flood maps (various scales), published secondary sources, U.S. Geological Survey (USGS) 7 1/2 minute topographic maps, and other sources, including derived data where necessary.

The Wild Rice-Marsh Rivers Subbasin is fairly representative of the kind of data available for other Red River subbasins in Minnesota. Flood Prone Area Maps published by the USGS, for example, provided detailed and accurate information for the area mapped. Coverage in the subbasin, however, was limited to three maps along the Main Stem Red River and one for the Mahnomen area.

Federal Insurance Administration Flood Hazard Boundary Maps and Flood Insurance Rate Maps provide important coverage of the Minnesota portion of the Red River Basin. The former are designed only to delineate the 100-year floodplain. The latter are much more detailed and usually more accurate. Clay County, comprising approximately the southwest half of the lower one-third of the subbasin, is covered by the more detailed rate map. Norman, Clearwater, and Becker counties comprise a majority of the subbasin and have flood hazard maps of their unincorporated areas. Mahnomen County currently has no flood map at all although it did join the emergency program in 1974.

Secondary sources, such as the Souris-Red-Rainy River Basins Type II Study (delineating the main stem floodplain) were also utilized. Published floodplain descriptions and acreage estimates in the Soil Conservation Service (SCS) Norman-Polk Watershed Work Plan, Wild Rice Watershed District Overall Plan, and other sources were consulted. Available U.S. Geological Survey 7 1/2 minute topographic maps of relevant areas included all of

seven maps and parts of eight others. Areas of coverage centered on the Red River, southeast, and central portions of the subbasin. In a few instances, data was inferred from other information.

As noted earlier, data from the above sources was compiled and delineated on USGS 250,000-scale maps. The floodplain indicated was then planimetered by segment, and figures in square inches were converted to land measure and rounded to the nearest 2,000 acres.

Appendix B

INVENTORY OF OUTDOOR RECREATIONAL FACILITIES, WILD RICE-MARSH RIVERS SUBBASIN

Appendix B

INVENTORY OF OUTDOOR RECREATIONAL FACILITIES (WILDLIFE MANAGEMENT AREAS)
WILD RICE-MARSH RIVERS SUBBASIN

Number	Name	Location	Boundary Acres	WMA Managed Acres	Date[1]
1	Agassiz-2 WMA	Norman Co. 14645W21 Gary	1,399.3	1,399.0	71
2	Agassiz-1 WMA	Norman Co. 14645W36 Gary	160.0	120.0	71
3	IDA WMA	Norman Co. 14445W12 Twin Valley	160.0	80.0	71
4	Rockwell WMA	Norman Co. 14345W03 Twin Valley	1,087.0		71
5	Vangsness WMA	Norman Co. 14344W03 Twin Valley	274.0	160.0	71
6	Faith WMA	Norman Co. 14443W26 Twin Valley	885.0	380.0	71
7	Dalby WMA	Norman Co. 14345W11 Twin Valley	120.0	120.0	71
8	Neal WMA	Norman Co. 14344W19 Twin Valley	1,963.3	878.0	72
9	Home WMA	Norman Co. 14344W13 Twin Valley	235.0	103.0	71
10	Twin Valley WMA	Norman Co. 14344W29 Twin Valley	235.0	160.0	71
11	Cupid WMA	Norman Co. 14345W36 Twin Valley	480.0		71
12	Syre WMA	Norman Co. 14344W27 Twin Valley	341.6	341.0	71
13	Moccasin WMA	Norman Co. 14343W35 Twin Valley	409.0	138.0	71

Appendix B (Cont'd)

INVENTORY OF OUTDOOR RECREATIONAL FACILITIES (WILDLIFE MANAGEMENT AREAS)
WILD RICE-MARSH RIVERS SUBBASIN

Number	Name	Location	Boundary Acres	WMA Managed Acres	Date[1]
27	Coburn WMA	Manhomen Co. 14342W31 Waubun	80.0	80.0	71
28	Waubun WMA	Mahnomen Co. 14342W33 Waubun	1,787.0	1,748.0	71
29	Clearwater-7 WMA	Clearwater Co. 14636W30 Mud Lake	4.0	4.0	71
30	Clearwater-19 WMA	Clearwater Co. 14537W01 Upper Rice Lake	40.3	40.0	71
31	Clearwater-5 WMA	Clearwater Co. 14536W05 Upper Rice Lake	24.3	24.0	71
32	Clearwater-20 WMA	Clearwater Co. 14537W01 Upper Rice Lake	23.7	23.7	71
33	Upper Rice WMA	Clearwater Co. 14537W02 Upper Rice Lake	321.0	321.0	71
34	Jackson WMA	Clearwater Co. 14538W18 Perch Lake	267.1	167.1	71
35	Clearwater-34 WMA	Clearwater Co. 14538W19 Lone Lake	15.5	15.0	71
36	Clearwater-27 WMA	Clearwater Co. 14438W07 Simon Lake	26.7	27.0	71
37	Clearwater-26 WMA	Clearwater Co. 14438W07 Simon Lake	14.3	14.0	71
38	Lower Rice WMA	Clearwater Co. 14438W02 Buckboard Creek	423.7	423.0	71
39	Clearwater-29 WMA	Clearwater Co. 14438W21 Wapatus Lake	34.7	35.0	71

Appendix B (Cont'd)

INVENTORY OF OUTDOOR RECREATIONAL FACILITIES (WILDLIFE MANAGEMENT AREAS)
WILD RICE-MARSH RIVERS SUBBASIN

Number	Name	Location	Boundary Acres	WMA Managed Acres	Date[1]
14	Killian WMA	Mahnomen Co. 14641W02 Foot Lake	80.0	80.0	71
15	Foot WMA	Mahnomen Co. 14641W12 Chief Lake	174.0	80.0	71
16	Mahgre WMA	Mahnomen Co. 14641W21 Bejou	180.0	50.5	71
17	Loncrace WMA	Manhomen Co. 14642W24 Bejou	253.8	40.0	71
18	Wambach WMA	Mahnomen Co. 14542W12 Bejou	1,280.6	1,280.0	71
19	Gregory WMA	Manhomen Co. 14641W33 Gregory Lake	665.0	411.0	
20	Vanose WMA	Mahnomen Co. 14641W36 Gregory Lake	2,848.5	1,831.0	71
21	Budde Meadows WMA	Mahnomen Co. 14540W02 Annawausch Lake	780.1	280.0	71
22	Warren WMA	Mahnomen Co. 14541W10 Warren Lake	64.7	64.7	71
23	Rush WMA	[illegible]nomen Co. [illegible]W20 [illegible]ke	1,139.0	690.0	71
24	Mah Soo WMA	Ma[illegible]en Co. [illegible]W26 Mahnomen	40.0		71
25	Beaulieu WMA	Mahnomen Co. 14540W20 Beaulieu	280.0	280.0	71
26	Bluestem WMA	Mahnomen Co. 14342W21 Moore Lake	20.0		71

Appendix B (Cont'd)

INVENTORY OF OUTDOOR RECREATIONAL FACILITIES (WILDLIFE MANAGEMENT AREAS)
WILD RICE-MARSH RIVERS SUBBASIN

Number	Name	Location	Boundary Acres	WMA Managed Acres	Date[1]
40	Clearwater-31 WMA	Clearwater Co. 14438W25 Blakely Lake	40.0	40.0	71
41	Clearwater-32 WMA	Clearwater Co. 14438W35 Siren Lake	35.5	35.0	71
42	Spring Creek WMA	Becker Co. 14242W12 Clarence Lake	800.0	644.0	71
43	Moccasin WMA	Becker Co. 14243W01 Walworth Township	63.0		71
44	Coburn WMA	Becker Co. 14242W05 Apple Lake	319.7	319.0	71
45	Olson WMA	Becker Co. 14242W18 Ogema	120.0	120.0	71
46	White Earth WMA	Becker Co. 14241W09 Duforte Lake	41.0	41.0	71
47	Felton WMA	Clay Co. 14246W36 Felton	1,053.4	400.0	71
48	Ulen WMA	Clay Co. 14245W25 Ulen	399.3	399.0	71
49	Aspen WMA	Clay Co. 14144W20 Hitterdal	40.0	40.0	71
50	Goose Prairie WMA	Clay Co. 14144W27 Goose Prairie Marsh	576.9	436.0	71
51	Lemon WMA	Clay Co. 14044W12 Melby Lake	67.3		71
52	Melbye WMA	Becker Co. 14143W31 Melby Lake	60.6	60.0	71

Appendix B (Cont'd)

INVENTORY OF OUTDOOR RECREATIONAL FACILITIES (WILDLIFE MANAGEMENT AREAS)
WILD RICE-MARSH RIVERS SUBBASIN

Number	Name	Location	Boundary Acres	WMA Managed Acres	Date[1]
53	Atlanta WMA	Becker Co. 14143W29 Melby Lake	138.8	138.0	71
54	Pednor WMA	Becker Co. 14142W08 Riceville Township	240.0	240.0	71
55	Ogema Springs WMA	Becker Co. 14141W06 Ogema	639.7	115.0	71
56	Teiken-Dalve WMA	Becker Co. 14241W34 Mission Lake	33.0	32.0	71
		Total Acres:	23,285.4	14,947.0	

[1]Date of latest information.

Source: Department of Natural Resources, Division of Parks and Recreation.

Appe...

INVENTORY OF OUTDOOR RE...
WILD RICE-M...
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Number	Name	Own	Administration	Location	Boundary Acres	Number of Resort Units	Campground			Wildlife Management Acres	Archeological Sites
							Primitive	Modern	Group		
(1)	White Earth State Forest	State	DNR[6]	Mahnomen Co. 145S9W14 Roy Lake Creek	41,617.0						
(2)	Roy Lake Lodge Resort	Private		Mahnomen Co. 144S9W01 Roy Lake	100.0	11	8	10			
(3)	Pine Hurst Resort and Campground	Private		Mahnomen Co. 144S9W32 North Twin Lake	25.0	15		45			
(4)	Broken Arrow Resort	Private		Mahnomen Co. 143S9W03 Bass Lake	93.0	6		3			
(5)	Braulick's Resort	Private		Mahnomen Co. 143S0W13 Snider Lake	99.0	4	1				
(6)	Little Elbow Lake State Park	State	DNR	Mahnomen Co. 143S9W27 Little Elbow Lake	3,127.0		23				
(7)	Ulen Municipal Park	Municipal		Clay Co. 142S4W28 Ulen	15.0			10			
(8)	Mahnomen Co. *Memorial Forest*	County		Mahnomen Co. 143S0W25 White Earth River	920.0						
(9)	Wabaunaquai Group Camp - BSA	Private		Becker Co. 142S0W16 White Earth Lake	440.0				145		
(10)	Woodland Trails Resort	Private		Becker Co. 141S0W01 Strawberry Lake	172.0	5		80			
(1)	Heart of the Valley Golf	Private		Norman Co. 144S6W16 Ada	62.0						

Appendix B

INVENTORY OF OUTDOOR RECREATIONAL FACILITIES[1]
WILD RICE-MARSH RIVERS
SUBBASIN

Resort Units	Campground						Marina					Trails (Miles)												
	Primitive	Modern	Group	Wildlife Management Acres	Athletic Field Acres	Golf	Canoe	Rental[2]	Storage[3]	Playground	Park[4]	Ramp	Picnic Table	Beach	Pool	Nature	Horse	Snow	Hike	Bike	Ski	Trout	Shooting Range	Rest Area	Fairground	Date[5]
	8	10						X	X	X	5	X		X												
		45						X			100	X		X												71
		3						X	X	X		X	10	X												72
	1							X	X		2															71
	23												10	X											X	72
		10								X			20			X										76
																										72
			145																							77
		80			4		X	X	X	X	10	X	70	X			3	3	2							77
						9																				74

-continued-

2

Number	Name	Own	Administration	Location	Boundary Acres	Number of Resort Units	Campground: Primitive	Campground: Modern	Campground: Group
(2)	Mahnomen Country Club	Private		Mahnomen Co. 1444ZW01 Mahnomen	80.0				

[1]Facilities included are limited to those with 15 or more acres.

[2]Boat rental.

[3]Boat storage.

[4]Parking spaces.

[5]Date of latest information.

[6]Department of Natural Resources.

Source: Department of Natural Resources, Division of Parks and Recreation.

Appendix B

OUTDOOR RECREATIONAL FACILITIES[1]
WILD RICE-MARSH RIVERS
SUBBASIN

Campground					Marina									Trails (Miles)								
Modern	Group	Wildlife Management Acres	Athletic Field Acres	Golf	Canoe	Rental[2]	Storage[3]	Playground	Park[4]	Camp	Picnic Table	Beach	Pool	Nature	Horse	Snow	Hike	Bike	Ski	Trout	Shooting Range	Rest Area	Fairground	Date[5]
				9																				7

2

Appendix C
COMMENTS

Appendix C

COMMENTS

The purpose of this subbasin report was to provide an overview of the water and related resource problems and needs and to assess potential solutions. Toward this end, draft copies of this report were circulated to Federal, State, and local agencies and comments were sought.

This review resulted in complete and factual documentation. Thus, the study should serve as a building block for the timely completion of future water resource efforts within the subbasin. Further cooperative efforts are, however, needed to evaluate these tentative results and to develop potential solutions.

A distribution list and copies of the comments made with respect to the draft report are included as part of this appendix. Comments that resulted in specific modifications to the draft text are marked by an asterisk.

DEPARTMENT OF THE ARMY
ST PAUL DISTRICT CORPS OF ENGINEERS
1135 U S POST OFFICE & CUSTOM HOUSE
ST PAUL MINNESOTA 55101

REPLY TO
ATTENTION OF:

NCSED-PB

28 July 1980

Mr. Mike Liffmann
Project Manager
Gulf South Research Institute
8000 GSRI Avenue
Baton Rouge, Louisiana 70808

Dear Mr. Liffmann:

The draft Wild Rice-Marsh Rivers subbasin report was distributed for review and comment. Most of the reviewers have sent their comments to us.

a. Inclosure 1 includes letters from various Federal and State agencies.

b. Inclosure 2 is the general office comments that need to be considered when preparing the final Wild Rice-Marsh Rivers subbasin report and the remaining subbasin reports.

c. Inclosure 3 identifies specific office concerns that are applicable to the final Wild Rice-Marsh Rivers subbasin report.

If you have any questions on our comments or proposed modifications, please contact us.

Sincerely,

George W. Kemp
for LOUIS E. KOWALSKI
Chief, Planning Branch
Engineering Division

3 Incl
As stated

United States Department of Agriculture
Soil Conservation Service
316 North Robert St., Room 200
St. Paul, Minnesota
55101

SUBJECT: 150-13 DAP, Red River of the North DATE: June 16, 1980

TO: William W. Badger, Colonel
Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, MN 55101

We have reviewed the Wild Rice-Marsh Rivers and Buffalo River Subbasin Draft Reports for the Red River of the North Reconnaissance Study being conducted under contract by the St. Paul District, U. S. Army Corps of Engineers. The following comments are provided for your consideration:

Wild Rice - Marsh Rivers Subbasin

1. The highway designations on the maps on pages 6, 11, 41, 50, 64, and 69, appear to be in disagreement with standard highway map designations. It appears that Highway 31 going through Ada should be designated Highway 200 and Highway 31 going north and south on the east side of the watershed should be designated as Highway 92.

*2. The second sentence on page 8 needs to be reworded for clarity.

*3. In the last paragraph on page 12, it is suggested that the first sentence in that paragraph be reworded as follows:

"Present average annual damages are estimated at $2,115,000."

4. The discussion on page 13 comparing the 1979 flood event with the average annual urban flood damages should be reviewed for accuracy. It does not seem realistic for damages for one large event to be less than the average annual figures. If that discussion is in error, changes should also be made in Table 1 on page 14.

*5. The first sentence in paragraph 3 on page 23 needs to be revised for clarity.

*6. On page 26, the term "two digit standard industrial classification (SIC)" is used. That term should be defined for the lay reader.

*7. On page 31, the second full sentence reads, "Some pheasant (less than one hen per square mile) and sharptailed grouse (1-6 adult males per square mile) probably occur. It appears that when the wording is specific as to the number that occur, the term "probably" should be stricken from the sentence.

*8. On page 37, paragraph 4 states that White Earth and Beltrami Island are the only state forests in the Minnesota portion of the Red River Basin. It appears that Buena Vista and Red Lake State Forest also are partially or wholly within the Red River Basin.

*9. On page 45, there is a discussion of various types of wetlands. In some cases, the "Type" is designated as a numeral and in other cases the numeral is spelled out. The writer should be consistent in designating the types of wetlands in the basin.

10. The last paragraph on page 65 states that "the adequacy of existing projects was not evaluated during the development of the study because the Corps of Engineers has indicated that present and projected proposed projects should be satisfactory to control the major flood problems in the subbasin." On page 66, the prime objectives are stated as, "The primary planning objectives of this study was to contribute to flood reduction needs in the subbasin and thereby provide protection from or reduction of flood lawsuits." If those statements are true, this study is not necessary.

*11. On page 71 in the second paragraph, it is suggested that the second sentence be modified to read, "The weighted average crop damage per acre flooded and other agricultural flood damages per acre multiplied by the average annual area flooded established total agricultural damages." Key word being average.

12. In Table 18 on page 72, it would be interesting to note how many reservoirs and miles of channel improvement were used to estimate figures in this table. Also, when talking about installation of farmstead levees; is this based on a unit basis or is this for one farmstead?

*13. On page 73, second paragraph, second sentence, it is suggested that the term average annual flood protection be used in place of average annual flood control.

Buffalo River Subbasin

1. The highway designation on the map on pages 4, 8, 39, 47, 49 and 63 show Highway 82 in the southern portion of the watershed. This designation should be changed to Highway 9.

2. In the third paragraph, page 57, it is suggested that starting with the third sentence, it read as follows:

"The SCS developed a plan for flood prevention and wildlife protection for the South of Hawley-South Buffalo Watershed. Planning assistance, however, has been suspended on this watershed. A preliminary investigation was also completed on the Deerhorn-Buffalo Watershed. Planning assistance was terminated on this project also."

3. In the second paragraph, on page 59, other types of measures for flood damage reduction are discussed. It should be clarified that the measures listed would only provide a small degree of flood damage reduction. The use of drainage ditches for flood water storage is questionable since this is contrary to the perceived purpose of efficient water removal. The installation of land treatment measures is voluntary and entirely up to the individual landowner.

There are numerous typographical errors detected throughout the report. It is suggested that a complete editorial review be provided prior to submitting this report to the public.

We appreciate the opportunity for reviewing this report. I hope these comments will be beneficial in completing this study in the Red River of the North.

Jon V. DeGroot
Assistant State Conservationist

cc: Ivan R. Wilkinson, RB&WSP Leader, SCS, St. Paul

USDA:SCS:IRWilkinson:WPC:jla:6/16/80

United States Department of the Interior

FISH AND WILDLIFE SERVICE

IN REPLY REFER TO:

St. Paul Field Office, Ecological Services
538 Federal Building and U.S. Court House
316 North Robert Street
St. Paul, Minnesota 55101

June 30, 1980

Colonel William W. Badger
Dist. Engineer, St. Paul Dist.
U.S. Army Corps of Engineers
1135 U.S. Post Office
St. Paul, MN 55101

Dear Colonel Badger:

This provides U.S. Fish and Wildlife Service comments on the Draft Reconnaissance Report recently compiled by Gulf South Research Institute for the Wild Rice-Marsh Rivers Subbasin in Norman, Clay, Polk, Mahnomen, Becker, and Clearwater Counties, Minnesota.

As expressed in our comments on previous Subbasin Reports, our major concerns are associated with the woodland, grassland, wetland, riverine, and riparian floodplain habitats that still remain within this Subbasin. Much of the woodland, grassland, and wetland habitat in the western one-third of the Subbasin (particularly west of the town of Ada) has been converted to agricultural uses. However, significant forested areas still exist within the eastern two-thirds of the Subbasin and along the Wild Rice River. Remaining wetland and grassland habitat is primarily confined to the eastern half of the Subbasin. We agree with the statements made on page 15 of the Report that there is a need to preserve and enhance the remaining grassland, wetland, and woodland habitats, create additional wildlife habitat, establish areas of natural beauty and scenic value, and improve the quality of the land and water resources within the Subbasin. We believe that the extensive drainage of wetlands, continued agricultural and residential development in floodplains, and unsound land use practices within the Subbasin need to be curtailed.

Wind and water erosion is also a serious problem in many areas, and we agree with the statements on pages 21 and 77 of the Report that land treatment measures (green belts, cover crops, reduction in fall tillage practices, etc.) are needed, and should be thoroughly investigated to help retain the soil on the land, reduce ditch and streambank erosion problems, and improve the water quality of the lakes and streams within the Subbasin.

Another area of particular concern is the Wild Rice River itself which contains a relatively significant river fishery, including walleye, sauger, channel catfish, and northern pike. A total of 31 species of fish representing 11 families have been identified to date within the river by the Minnesota Department of Natural Resources. The Wild Rice River also has the potential to support a good smallmouth bass fishery because its physical

characteristics (alternating pattern of riffles and pools) are typical of some of Minnesota's best smallmouth bass streams. As such, no actions and/or measures should be undertaken within the Subbasin that would inappropriately degrade this important riverine resource.

The Subbasin contains various Wildlife Management Areas (WMA's), Waterfowl Production Areas (WPA's), and Scientific and Natural Areas (SNA's) that provide important habitat for many species of wildlife. These areas are also significant because of the outdoor recreational activities they provide and, as such, should be preserved within the Subbasin.

The Report addressed various structural alternative measures that have been identified to date to meet the study's flood damage reduction objective. These measures and our comments relative to each are as follows:

Alternative 1 (Twin Valley Lake Reservoir) -- This alternative would involve the construction of an earthen dam and reservoir on the Wild Rice River east of the town of Twin Valley. Total storage capacity of the reservoir would be 52,200 acre-feet, of which 44,700 acre-feet is allocated for flood control storage, which could control about a 77-year frequency flood at Twin Valley. The Fish and Wildlife Service has substantial concerns, as previously expressed, with this proposal in terms of its potential significant adverse impacts on fish and wildlife resources and the water quality of the Wild Rice River. The proposed project would convert a 7-mile reach of the Wild Rice River from a free flowing stream of important fishery value to a reservoir-type of environment. A permanent loss of the present bottom and streamside ecosystem would result. The Wild Rice River Valley and floodplain area is a floristically rich ribbon of mixed hardwood forest surrounded by a predominantly agricultural area. The proposed project initially would destroy approximately 540 acres of riparian habitat in the conservation pool and would modify an additional 1,100 acres of riparian and upland habitat in the flood pool. Animal populations currently inhabiting the impoundment area would be eliminated or would migrate from the area. Some of the wildlife species that would be adversely affected include deer, beaver, mink, raccoon, fox, squirrel, ruffed grouse, and an abundance and variety of birds. Additional project impacts are addressed in the Final Environmental Impact Statement: Twin Valley Lake, Wild Rice River, Minnesota, 1975. This project would be considered acceptable to the U.S. Fish and Wildlife Service only if the unavoidable adverse impacts of the project on fish and wildlife resources are adequately compensated. The present compensation plan is outlined in the U.S. Army Corps of Engineers' April 22, 1980 preliminary draft of the Fish and Wildlife Compensation Plan.

Alternative 2 (Reservoir and Channel Improvements) -- This alternative would involve the construction of a number of reservoirs providing 14,600 acre-feet of storage and 36 miles of channel improvements within the Subbasin as set forth in the Souris-Red-Rainy River Basins Study (1972). The locations of these proposed reservoirs and channel improvements were not identified in the Report. We believe that shallow upstream reservoirs should only be constructed in those specific locations where floodplain values would be enhanced by such development and therefore comply with Executive Order 11988 (Floodplain Management). Our comments with respect

to the proposed channel improvements are the same as previously provided in our comment letter of May 8, 1980 relative to Alternative 1 in the Draft Reconnaissance Report on the Tamarac River Subbasin. We would be especially concerned of any proposed channelization of the Wild Rice River because of its substantial fishery value.

Alternative 3 (Farmstead Levees) -- This alternative would involve the construction of levees around farmsteads to provide protection against a 1.0% (100-year) frequency flood. The total amount of fill placed on the floodplain in association with levee construction would be 5.0 acres. We do not anticipate any significant adverse environmental impacts due to this alternative provided that the dikes are not constructed through wetland areas and impacts to existing woodland and grassland vegetation are avoided to the extent possible.

The Report indicated on page 68 that several flood reduction proposals by the Wild Rice Watershed District would also be implemented within the Subbasin. Irrespective of federal involvement (funds, assistance, etc.) or not, these proposals should be identified and evaluated in conjunction with the adequacy of existing project measures to determine what extent they would resolve the major flooding problems within the Subbasin.

Some non-structural measures were also briefly discussed on pages 63, 65, 68, 70, 77, and 78 of the Report. We believe a plan involving a combination of structural and nonstructural measures (as identified on page 4 of our previous letter on the Draft Reconnaissance Report for the Tamarac River Subbasin) should be implemented.

We agree that additional studies (particularly numbers 3, 7, 17, and 18 addressed on pages 77 and 78 of the Report) need to be undertaken to provide a more detailed and in-depth analysis of existing Subbasin problems and the potential solutions to many of these problems. We also believe that the study addressed on page 70 of the Report, which is being initiated by the Upper Mississippi River Basin Commission to determine the effect of agricultural land drainage practices on flows of the Red River of the North, is badly needed. We contend that wetland drainage has been the single most contributing factor to the substantial flooding problems that are now being encountered within the Red River Basin and along the Red River of the North.

Generally, we believe the Draft Report was well written. We suggest, however, that the following changes be made in the Final Report:

*1. Page 31, last paragraph, 6th sentence -- We suggest this sentence, "Channel catfish are also fished in the fall" be deleted and replaced with the following two sentences: Good walleye and northern pike fishing exists in the pools of the Beaulieu area and the lower part of the river near Hendrum. Highway 75 is also a favorite location for catching walleye and channel catfish, particularly in the fall.

*2. Page 32, 1st sentence at the top of the page -- Change this sentence to read: The Wild Rice River also has the potential to support a good smallmouth bass population since its physical characteristics (alternating pattern of riffles and pools) are typical of some of Minnesota's best smallmouth bass streams.

*3. Page 40, 3rd paragraph, 2nd sentence -- Change this sentence to read: In addition, there are numerous federal Waterfowl Production Areas within the Subbasin that are open to the public for waterfowl and upland, small, and big game hunting.

*4. Page 45, 2nd sentence from the top of the page -- change this sentence to read: Table 11 gives 1964 wetland data for Type 1, 3, 4, and 5 wetlands in Polk, Mahnomen, Becker, and Clay Counties, Minnesota. No wetland data were obtained for Clearwater and Norman Counties.

*5. Page 45, 1st paragraph, last sentence -- Change this sentence to read: These data show that the wetland numbers and acreages within these five counties were reduced by 3,095 and 8,828 acres, respectively, during the 10-year-period from 1964 to 1974.

*6. Page 45, last paragraph under the heading Waterfowl Production Areas -- Change this paragraph to read: Numerous federal Waterfowl Production Areas (WPA's) are located within the Wild Rice-Marsh Rivers Subbasin. These are wetland areas that the U.S. Fish and Wildlife Service (USFWS) has either acquired through fee title or obtained an easement interest on to preserve valuable breeding, nesting, and feeding habitat for migratory waterfowl. These wetland areas are purchased, or an easement interest obtained, with funds received from the sale of Migratory Bird Hunting and Conservation Stamps ("Duck Stamps"). These WPA's are significant because they provide the public with a great variety of wildlife-oriented recreational opportunities as well as provide valuable habitat for migratory waterfowl and many other forms of wildlife. The USFWS is responsible for the compatibility determinations (uses) and the issuance or denial of permits involving these lands. The approximate locations of these WPA's (fee tracts) within the Subbasin are shown in Figure IV. Total acreage of these WPA's (fee and easement) in Clay, Becker, and Mahnomen Counties are listed in Table 14.

*7. Page 49, Table 14 -- Remove the cost column which is not necessary in this Report and type Fee (Acres) and Easement (Acres) above the appropriate acreage columns. In addition, change the title to read: Acres of federal Waterfowl Production Areas (fee and easement) in three of the six counties within the Wild Rice-Marsh Rivers Subbasin. The asterick sentence under the Table should also be changed to: "Norman, Polk, and Clearwater Counties have no WPA's within the Subbasin."

*8. Page 50, Figure IV -- Type "Fee Tracts" in paranthesis after Waterfowl Production Areas in the legend. We believe that at least 13 additional WPA's should also be identified by a dot in Figure IV (eight WPA's in Becker County, three in Mahnomen County, and two in Clay County). We have attached a copy of Figure IV indicating the approximate locations of these WPA's.

*9. Page 51, 2nd paragraph under Other Important Species, 3rd sentence -- Change this sentence to read: The greater prairie chicken is primarily restricted to the remnant native prairie tracts in the Lake Agassiz beachline area of the Subbasin.

*10. Page 51, 2nd paragraph under Other Important Species, 5th sentence -- Change this sentence to read: The Franklin's gull utilizes a colonial bird nesting site in the Felton-Ulen area. .

*11. Page 65, 2nd paragraph, last sentence -- We suggest this sentence be changed and the following statements be included in this paragraph: Information on natural storage areas and potentialities for increased storage is very limited. Indications are, however, that wetlands play a substantial role in controlling runoff, especially in combination with good land treatment practices. Values on storage have averaged about 12 inches per surface-acre of wetlands and have ranged to four times that amount (Cernohous, 1979). The amount of wetland habitat within the watershed area (or Subbasin) is important: statistical studies indicate that in certain situations if a watershed has 15% of its area in wetlands or lakes, peak floods will be 60-65% lower than they would be in the absence of the wetland/lake area; if wetlands or lakes occupy 30% of the watershed, there will be a further reduction in flood peaks up to about 75 or 80% (Scientists' Report, National Symposium on Wetlands, 1978).

12. Page 76, 2nd paragraph -- A statement should be made in this paragraph indicating that the unavoidable adverse impacts of this project (Twin Valley Lake) on fish and wildlife resources will be adequately compensated.

*13. Page 78, number 17 -- We suggest this be changed to read: The effect of wetland drainage on flood discharges and stages. It would take additional and more detailed studies to determine the extent and effect of reduced natural storage.

*14. Page 82, Bibliography -- Include the following reference on this page:

National Wetlands Technical Council. 1978. Scientists' Report. National Symposium on Wetlands. 129 pp.

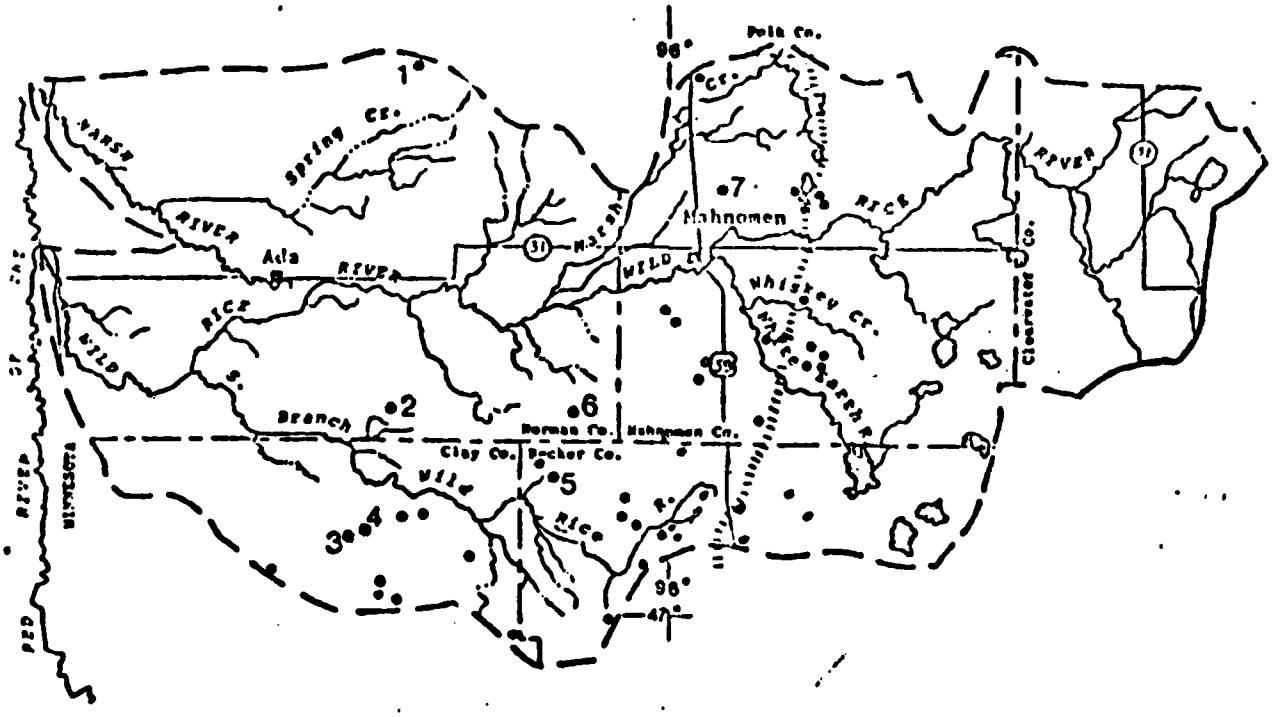
These comments have been prepared under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and are consistent with the intent of the National Environmental Policy Act of 1969.

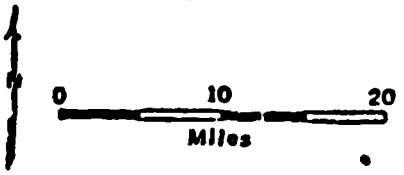
Sincerely,

Richard F. Berry

Richard F. Berry
Field Office Supervisor

cc: Minn. DNR, St. Paul
S. Bittner, Gulf South Res. Inst., New Iberia





- SCIENTIFIC AND NATURAL AREAS
  - 1 Agassiz Dunes (Partial)
  - 2 Twin Valley Prarie
  - 3 Clay County Bicentennial Prarie
  - 4 Blazing Star Prario
  - 5 Zimmerman Prarie
  - 6 Frenchman's Bluff
  - 7 Santee Prario
- WATERFOWL PRODUCTION AREAS (FEE TRACTS)

rce: The Nature Conservacy (no date); Miles and Yaeger (1979); U. S. Fish and Wildlife Service (1980).

Figure IV. WATERFOWL PRODUCTION AREAS AND SCIENTIFIC AND NATURAL AREAS

DEPARTMENT OF THE ARMY
NORTH CENTRAL DIVISION, CORPS OF ENGINEERS
536 SOUTH CLARK STREET
CHICAGO, ILLINOIS 60605

NCDPD-PF

1 JUL 1980

SUBJECT: Wild Rice - Marsh Rivers Subbasin Reconnaissance Report

District Engineer, St. Paul

1. Reference NCSED-PB letter undated, subject as above.

2. Inclosed are NCD comments on subject report.

FOR THE DIVISION ENGINEER:

KENNETH H. MURDOCK
Chief, Planning Division

Incl
as

NCDPD-PF

1 JUL 1980

SUBJECT: Wild Rice - Marsh Rivers Subbasin Reconnaissance Report

District Engineer, St. Paul

1. Reference NCSED-PB letter undated, subject as above.

2. Inclosed are NCD comments on subject report.

FOR THE DIVISION ENGINEER:

Incl
as

KENNETH H. MURDOCK
Chief, Planning Division

Department of the Army

NORTH CENTRAL DIVISION

Corps of Engineers

SUBJECT: Wild Rice - Marsh River Subbasin Reconnaissance Report - May 1980

Cmt. No.	Page & Para.	Comment
1	Pg. 11	Figure II is a poor map cartographically. Include a legend which clearly describes the patterning used to delineate the 100-year flood plain, marshy areas, etc.
*2	Pg. 23	Indicate whether the views of the local public officials gained from sample surveys of 100% surveys. Indicate the source of the information.
*3	Pg. 63	Suggest modifying the explanation of nonstructural measures to incorporate the following thoughts. "Nonstructural measures modify the susceptibility of land, people, and property to damage or losses. In addition they modify the impact of flooding upon people and communities. Nonstructural measures do not attempt to modify the behavior of flood waters."
4	Pg. 67	The list of objectives are basically good but awkwardly written. Would suggest rewriting such as below. "Enhance the recreational opportunities in the Wild Rice-Marsh Rivers Subbasin for the benefit of the local people."
*5	Pg. 68	Suggest the addition of a note to the discussion of alternative 1 concerning the current status of the authorization. Even though the project is authorized for construction, funds have never been allocated for this purpose. In the future, funds for construction are dependent upon the finding and results of new studies of this alternative.
6	Pps. 69 & 70	A combination of structural and non-structural alternatives should be included. As well as discussion on such things as the least environmentally damaging plan, and the NED & EQ alternatives.
*7	Pg. 70	Number 5 is not an alternative, it's a study to help develop alternatives.
8	Pps. 71-76	The assessment and evaluation sections need to emphasize how each alternative meets or doesn't meet each objective both study objectives and National Objectives.

SUBJECT: Wild Rice - Marsh River Subbasin Reconnaissance Report - May 1980

CMT. No.	Page & Para.	Comment
9		The adverse effects to the basin's wildlife and vegetational resources has been grossly understated. It is suggested that if this subbasin becomes part of the final reconnaissance report (feasible alternatives are recommended for further study) that the impacts discussed in the FEIS, FWS Coordination Act Report and Draft Supplemental EIS be detailed.

DEPARTMENT OF NATURAL RESOURCES
444 Lafayette Road, Space Center Bldg., St. Paul, MN 55101
PHONE 612/296-4800

July 3, 1980

Colonel William W. Badger
St. Paul District
Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, MN 55101

Dear Colonel Badger:

COMMENTS ON BUFFALO RIVER AND WILD RICE-MARSH RIVERS SUBBASIN REPORTS

The Department of Natural Resources, Division of Waters has reviewed the above referenced documents. I think that most of the Division's substantive comments have already been made in connection with the other four subbasin reports that have been reviewed to date. I will not repeat these comments and concerns and I hope that the contractor will view those comments as applying to all of the subbasin reports as revisions are made in the documents.

It is apparent after reviewing six subbasin reports that most structural measures will not be economically feasible for construction. It is also apparent that the contractor has not spent very much time looking at very small projects where no Corps participation is possible or at non-structural alternatives such as relocation/aquisition or large scale land treatment programs.

Basically what has been presented in these documents is a reassessment of programs and projects that were proposed over the last twenty years. Most of these projects were not economically feasible when they were proposed and most of them are less economically feasible today.

The Reconnaissance Study was supposed to take an innovative approach to flood damage reduction in the Red River Valley. I realize the constraints of working with secondary data or no data at all, but we are getting very little useful information out of the documents. During the early stages of the study it was hoped that the final report identify a course of action that would reduce a significant amount of the flood damages in the Red River Valley. At this stage it does not appear that this will be the case.

To date, the only conclusion that can be drawn is that there are very few programs and projects that the Corps can participate in under existing authorities. The reports also do not provide enough information for state or local governments or individuals to develop comprehensive flood damage reduction plans.

It may be appropriate to have a meeting to discuss the future revisions to these documents. If the substance of the documents does not change we seriously question the continued expenditure of time and money to this activity at any level. Thank you for the opportunity to comment. If you have questions please contact Joe Gibson at 296-0438 or Ron Harnack at 296-0440.

Sincerely,

DIVISION OF WATERS

Larry Seymour
Director

LS/JG:ph

cc: Joe Gibson
Ron Harnack
Gerald Paul

GENERAL COMMENTS
WILD RICE-MARSH RIVERS SUBBASIN DRAFT REPORT
(MAY 1980)

(These comments apply to the entire report and all subsequent subbasin documents.)

1. As indicated in the specific comments, this document needs additional detailed information concerning nonstructural alternatives. The overall report should address and clarify this aspect of flood damage reduction planning.

2. Comments from Federal, State, and local agencies and a letter from the St. Paul District will be included in an appendix in each final subbasin and in the overall report. The format for the appendix will be:

a. Introduction - This section should stress:

(1) The importance of completing the study on time.

(2) That the purpose of the study is to advise other agencies and interests.

(3) The need for a selected review by various interests to provide complete and factual documentation.

(4) The use of the study as a building block for future water resource efforts.

(5) That cooperative efforts to evaluate results and develop solutions to remaining problems will be incorporated.

(6) A complete public involvement program when the study is finished.

b. The distribution list.

c. Copies of letters of comment.

Only comments that identify significant errors or need specific attention will be addressed in the final subbasin report. However, all comments incorporated should be identified with a marking system. The distribution list for the Wild Rice-Marsh Subbasin Report is given below:

Agencies receiving draft report	Date sent	Date comments received
Federal		
Soil Conservation Service	30 May 80	16 Jun 80
Fish and Wildlife Service	30 May 80	30 Jun 80
Corps of Engineers, North Central Div.	30 May 80	20 Jun 30
Corps of Engineers, St. Paul District	20 May 80	12 Jun 30

Incl 2

State

Water Planning Board	30 May 80	-
Department of Natural Resources	30 May 80	3 Jul 80
Planning Agency	30 May 80	-
Water Resources Board	30 May 80	-

Local

Watershed District	30 May 80	-

3. The source for most information identified in the majority of the tables is Gulf South Research Institute. If other sources were used, an appropriate reference should be made.

4. The evaluation section of each report in essence is the recommendations of the document. Generally, only the alternatives (structural) which have a benefit-cost ratio greater than 1.0 are presented. Little attention is given to the other alternatives whether structural or nonstructural which may be an important aspect of future flood damage reduction planning for either the subbasin or the overall basin. Some of these alternatives may provide the necessary environmental conditions to warrant further study. As a consequence, this section should be expanded and provide the discussions, as appropriate.

5. Rather than stating in each report and for each alternative evaluated that there will be no or negligible effects on cultural resources, the report should indicate that it is not possible to identify effects on cultural resource until a systematic cultural resources survey has been completed in the subbasin. Such statements are misleading because the report implies that no significant sites are in the subbasin. In reality, there are simply no known sites, and the document and tables should be modified, as appropriate.

6. The backup information for alternatives including technical, economic, and any environmental data should be provided (at least under separate cover). This would simplify matters when questions are asked during review or in the future.

7. The maps should have more detail. Often information in the text is not clearly indicated on the maps. The maps would be improved if reproductions were better quality and included township lines or relationships of the subbasin to county and State lines.

SPECIFIC COMMENTS
DRAFT WILD RICE-MARSH RIVERS SUBBASIN REPORT
(MAY 1980)

*1. Page 5 - The report states that the basin covers 1,950 square miles and then notes that the total drainage area is 1,248,000 acres. If total drainage area is meant to be the same as total basin area, the figure is accurate but redundant. If total drainage area means total effective drainage area, does this mean that there is no noncontributing drainage area in the basin? (1950 square miles x 640 acres per square mile = 1,248,000 acres.)

2. Page 5, last paragraph - It is unclear what is meant by a "maximum depth of 75 feet."

3. Page 6, Figure 1 - Diversion from Marsh River should be indicated more clearly.

4. Page 7, first paragraph - Because of the topography of the basin, the width of the mouth of the Marsh River valley should be listed as appropriate.

*5. Page 8, first paragraph, second sentence - Should it read "...analysis of conditions and public and agency comments."

*6. Page 8, last paragraph - "...it may be impossible to engage in planting operations altogether." Does this ever happen? Can't they always go to shorter term crops?

*7. Page 9, last paragraph - The statement that "peak flows on both rivers often correlate with peak flows on the Red River" does not agree with paragraph 30 of Appendix A of "Flood Control, Wild Rice River-South Branch and Felton Ditch, Minnesota, Design Memorandum No. 1, Phase II." According to paragraph 30, any increase in discharge caused by the proposed project on South Branch Wild Rice and Felton Ditch will normally reach Halstad well before the main stem Wild Rice River peak flow.

*8. Page 10, 3rd paragraph - The floodplain is described as approximately 70,000 acres. On page 55, 4th paragraph, the flood-prone area is 125,000 acres. What is the basis for floodplain versus flood-prone acreage that would account for this difference.

*9. Page 11, Figure II - Cannot tell where floodplain is or area it covers.

*10. Page 13, 2nd paragraph - The damage figures quoted here do not correlate with those given on table 2, page 14.

*11. Page 17, 4th paragraph - Typing error - "caused" misspelled.

*12. Page 22, first paragraph - Expand "improvements along the South Branch" to improvements along the South Branch Wild Rice River and Felton Ditch.

*13. Page 22, last paragraph, last sentence - Insert "by" after "...may be proposed."

*14. Page 23, 3rd paragraph, second sentence - Does not appear to belong to the rest of the paragraph.

* 15. Page 25, 2nd paragraph - Unclear as to whether or not the $4,581 and $6,892 figures are also expressed in 1979 dollars.

16. Page 27, Table 5 - Under estimated employment, what do the numbers represent?

17. Page 28, Climate Section - Clarify the number of inches of snow that fell as opposed to the equivalent amount of precipitation. Perhaps an explanation of conversion from snow to precipitation should be included.

* 18. Page 28, Climate Section, first sentence - Currently is misspelled.

* 19. Page 30 - Reference to the Fish and Wildlife Service habitat typing in the Twin Valley Lake and compensation areas should be deleted or the terminology explained (especially upland and lowland hardwoods or brush). These areas were based on elevations and may consist of different species in other situations.

* 20. Page 37, last paragraph - Should be 9,900 BC not B.P.

* 21. Page 42, 2nd paragraph - Proposed is misspelled.

22. Page 43, Water - The 2.4-percent figure should be rechecked. The surface area of rivers and lakes is believed to be substantially greater.

23. Page 43, Woodlands - The discussion on woodlands should indicate that woodland areas are also considered to be signficant within the subbasin because of the relatively small area they cover in comparison to agricultural areas. This is especially true for the western portion of the subbasin (Polk, Norman, Clay and part of Mahnomen Counties).

24. Pages 46-48 - Very difficult to see correlation between individual tables of the 1964 and 1974 wetland inventories and the comparison table on page 48. The figures given in the first two tables did not seem to match what was given in the final table.

* 25. Pages 49-51, Treatened or Endangered Species - The peregrine falcon has apparently been exterpated from Minnesota since the early 1960's. Although the subbasin does lie within the migratory route of the peregrine falcon and sitings may occur in the subbasin at that time, the wintering range of this species is south of this subbasin.

* 26. Page 52, 2nd paragraph - Squirrel is misspelled.

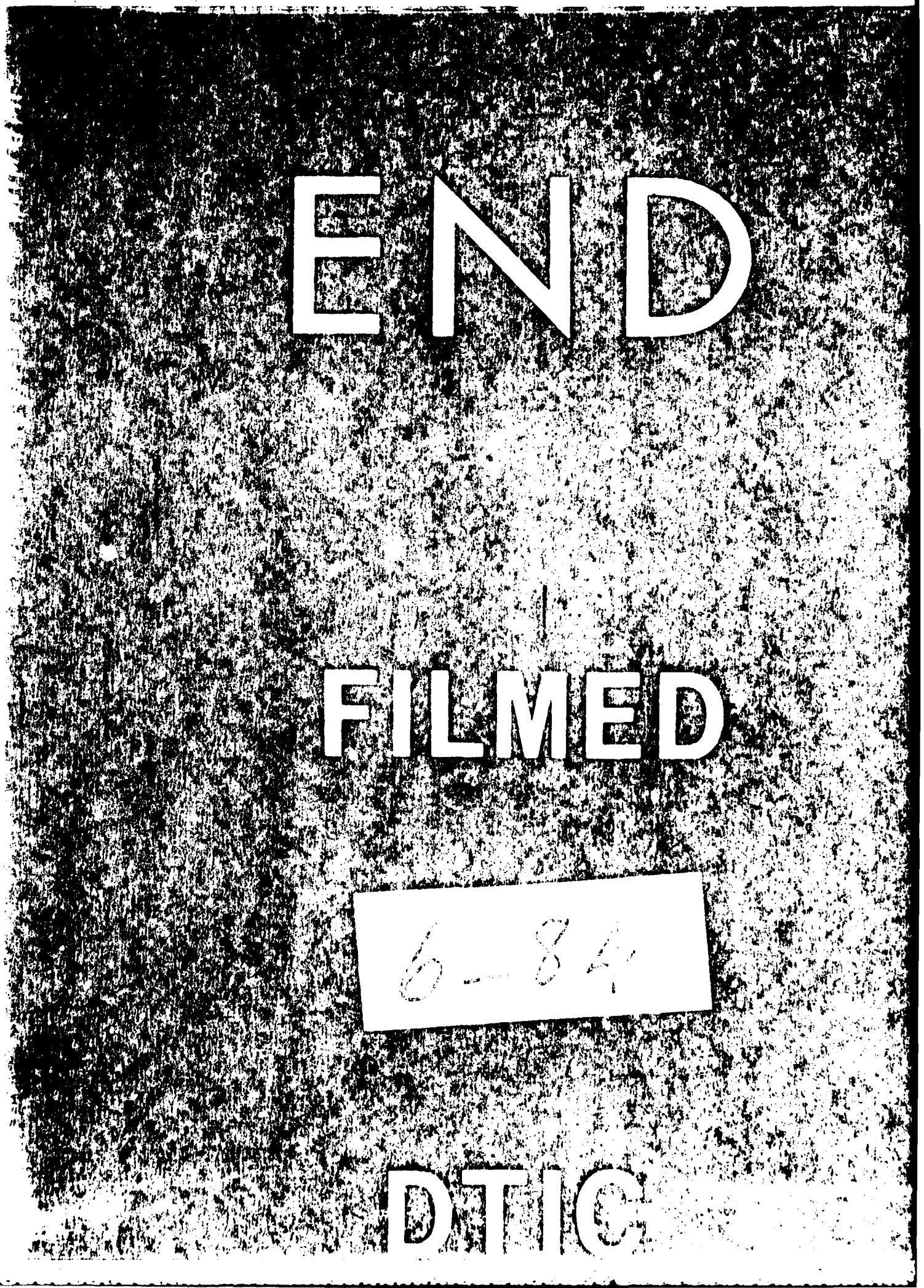
* 27. Page 63, first paragraph - The emergency bank protection at Mahnomen under Section 14 will probably be constructed this summer.

* 28. Page 64, Figure V - Work on the South Branch of the Wild Rice River is authorized but not completed as shown.

* 29. The second paragraph should be changed to read: "The development of planning objectives involved a broad-range analysis of the needs, opportunities, concerns, and constraints of the subbasin from the information available. On the basis of this analysis of identifiable problems, needs, and desires, the following planning objectives were established."

*30. Page 75, paragraph 4 - Twin Valley Lake would not affect the cultural resources. This is true for the pool area which has been surveyed; however, the same cannot be said in other project lands, borrow areas, etc.

*31. Page 75, paragraphs 5 and 6 - One cannot say cultural elements would not be affected. Only a very small portion of the subbasin has been thoroughly surveyed. There may be undiscovered or unlocated sites which would be affected.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